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Adolescent substance use: Latent class and transition analysis

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HIGHLIGHTS

- The study identified three adolescent substance use statuses.
- Longitudinal analysis showed that youth generally remained in the same statuses.
- If youth transitioned, they moved to a more harmful substance use status.
- Males were more likely than females to be polysubstance users.

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ABSTRACT

Background: The prevention and intervention of adolescent substance use is a public health priority. Most adolescents will engage in some form of substance use, and a sizeable minority will transition to using multiple substances. An emerging body of research takes a person-centered approach to model adolescent substance use over time; however, the findings have been equivocal. Our study modeled adolescent substance use transition patterns over three years based on a comprehensive list of substances and examined gender as a moderator.
Methods: We used three annual waves of data (Time 2, Time 3, and Time 4) from an ongoing longitudinal study of an ethnically diverse sample of 1042 adolescents originally recruited from multiple high schools in southeast Texas. Participants were 56% female, 32% Hispanics, 30% Whites, 29% African Americans, and 9% other with an average of 16.1 years (SD = 0.79) at Time 2. Data were analyzed using latent transition analyses.
Results: The study identified three substance use statuses (Mild Alcohol Use, Alcohol and Moderate Marijuana Use, and Polysubstance Use) and suggested that adolescents generally remained in the same statuses over time. When they did transition, it was typically to a more harmful substance use status. Further, males were more likely than females to be polysubstance users and had higher probabilities of transiting to and remaining in a more harmful drug use status.
Conclusions: The study identifies overall and gender specific adolescent substance use transition patterns, which are vital to informing intervention development.

1. Introduction

Adolescent substance use is a significant public health concern that is linked to a range of mental and physical health consequences, as well as risky behaviors such as dating violence (Vagi, Olsen, Basile, & Vivolo-Kantor, 2015), unsafe sexual practices (Ritchwood, Ford, DeCoster, Sutton, & Lochman, 2015), and delinquency (Monahan, Rhew, Hawkins, & Brown, 2014). Moreover, adolescent substance use tends to co-occur, and teens who use one substance (e.g., alcohol) have an increased likelihood of using another substance (e.g., marijuana) (Moss, Chen, & Yi, 2014; Tomczyk, Isensee, & Hanewinkel, 2016). Adolescent polysubstance users, that is, teens who use more than one substance within a specified period of time, either simultaneously or separately (Conway et al., 2013), are especially vulnerable to developing an addiction and to be involved in violence and other risky behaviors (Hopfer, Tan, & Wylie, 2014; Wanner, Vitaro, Carbonneau, & Tremblay, 2009).

Given the potentially severe consequences of polysubstance use, a number of studies have attempted to describe this pattern using person-centered approaches, such as latent class analysis (LCA) (see Tomczyk et al., 2016 for a review). LCA uses cross-sectional data to identify latent classes of substance use that reflect relatively distinct subgroups

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(Collins & Lanza, 2010). Using LCA, Connell, Gilreath, and Hansen (2009) examined 13,953 adolescents aged 14–18 and based on their alcohol, tobacco, marijuana, heavy episodic drinking, cocaine, inhalants, and other drug use, identified four classes: non-users, alcohol experimenters, occasional polysubstance users, and frequent polysubstance users. Another study (Conway et al., 2013) examined 2524 10th graders and identified four classes: non-users, predominant alcohol, predominant marijuana, and predominant polysubstance users.

Although identifying adolescent substance use patterns at a given time is a good first step, knowing how these patterns change over time is essential for designing prevention and intervention programs. The gateway hypothesis suggests that adolescents typically start with legal substances (e.g., alcohol, tobacco) and progress into illicit drugs (Kandel, Yamaguchi, & Klein, 2006). A better understanding of transition patterns will inform intervention development and allow for more precise timing that aims to prevent transitions from nonuse to use, or from low-use to higher use profiles (Steinman & Schulenberg, 2003).

LTA, the longitudinal extension of LCA, is a statistical tool that can fulfill the needs of modeling adolescent substance use transitions over time (Collins & Lanza, 2010). It can be used to estimate the continuity of substance use at adjacent time points, whether the transition is forward (e.g., transition from using one substance to using two) or backward (e.g., transition from using one substance to nonuse). Mistry et al. (2015) examined 850 10th graders (Time 1) and followed them over 4-years (Time 2 at 24 months and Time 3 at 48 months). By examining the transition across the identified three statuses (non-users, alcohol and marijuana users, and alcohol, tobacco and marijuana users), the authors concluded that there was less stability between Time 1 and Time 2 than between Time 2 to Time 3. Despite the importance of identifying population groups for interventions, findings of substance use patterns have been equivocal due to methodological differences including sample age range, recruitment strategy, time frames used, and what was analyzed (e.g., types of substances) (Tomczyk et al., 2016). Most adolescent substance use LTA research focuses on the use of alcohol, marijuana, and cigarettes (Chung, Kim, Hipwell, & Stepp, 2013; Maldonado-Molina & Lanza, 2010; Mistry et al., 2015). One study examined alcohol, cannabis, cocaine, and other hard drugs, but did not include marijuana or cigarette use (Hyucksun Shin, 2012). In general, relevant studies using LTA fail to include a comprehensive number of substances, and the misuse of prescription drugs has been absent. By examining the transition patterns of adolescent use of a comprehensive list of substances, including prescription drugs, the present study fills this literature gap.

Because existing research indicates differences in adolescent substance use between males and females, we will also examine the role of gender in transitioning substance use status. Lanza, Patrick, and Maggs (2010) compared male and female college freshmen and concluded that, although the underlying structures of substance use behaviors between males and females were similar, the prevalence of substance use differed across time. Thus, our study aims to identify the substance use patterns of both male and female adolescents, describe the prevalence of each status at each time point, and to examine and compare the transition patterns between males and females.

2. Materials and methods

2.1. Procedure

Data were from *Dating it Safe*, an ongoing longitudinal study of adolescent health. Participants were recruited during attendance-mandated classes at seven public high schools in southeast Texas (response rate: 62%). Ninth or 10th graders at baseline (N = 1042) participated in annual surveys from Spring 2010 (Time 1) to Spring 2018 (Time 8). The current study used data from Times 2 (retention rate: 95%), 3 (retention rate: 85%) and 4 (retention rate: 75%) as these waves included all relevant measures. Well-trained project managers administered a paper/pencil survey to participants in their classrooms. When participants were not available at school (e.g., moved to different local area), they completed the survey online. Participants received a $10 gift card at Times 2 and 3, and a $20 gift card at Time 4. We received written parental consent and student assent. The Institutional Review Board at the last author's institution approved all study procedures.

2.2. Participants

Slightly over half of students were female (56%) and approximately one third of adolescences self-identified as Hispanic (32%), White (30%), or African American (29%), with 9% reporting “other.” At baseline, the mean age of participants was 15.1 years (SD = 0.79); they reported highest parental education (either parent) as finished college (37%), some college/training school (28%), finished high school (19%), or did not graduate from high school (16%).

2.3. Measurements

2.3.1. Past-year substance use (Time 2, 3, & 4)

Participants reported their past-year substance use with a yes/no format. Each substance was asked using the following stem: “Since your last survey (about 1 year ago), did you use any: 1) alcohol (more than just a few sips), 2) cigarettes (more than just a puff), 3) marijuana, 4) cocaine (power, crack, or freebase), 5) amphetamines (speed, crystal, crank, ice), 6) inhalants (sniffed glue, huffing), 7) over the counter cold or cough medicine with the intent of getting high, 8) Ecstasy (MDMA, X, XTC, E), and 9) prescription drugs that weren't prescribed by a health professional?” Because of the relatively low prevalence of cocaine, amphetamines, inhalants, over the counter medicine, and ecstasy, they were collapsed into a single “other drug” variable.

2.4. Analytical plan

Five substance use indicators included alcohol, tobacco, marijuana, prescription drugs, and other drugs. We first performed LCA at each time point. To identify the optimal number of statuses, the following were used (Tofighi & Enders, 2008; Yang, 2006): 1) the Bayesian Information Criterion (BIC) and adjusted BIC (Nylund, Asparouhov, & Muthén, 2007) and 2) the adjusted Lo-Mendell-Rubin likelihood ratio test (LMR; Lo, Mendell, & Rubin, 2001). Smaller values in the adjusted BIC indicates a better fitting model. LMR test indicates a significant model fit improvement from k-1 to k class. We also considered conceptual interpretations of classes based on existing literature (e.g., Tomczyk et al., 2016).

After determining the optimal number of classes at each time point, we performed LTA to examine the measurement invariance across time. Two models were tested, one restricted item-response probabilities across waves (BIC = 10,438.615) and the other did not restrict item-response probabilities across waves (BIC = 12,175.349). The smaller BIC value of the restricted model indicated better model fit, suggesting that there were three equivalent substance use classes at Times 2, 3 and 4. Separately tested LCA models in females and males resulted in the same optimal numbers of classes (i.e., 3 classes) across time. We also tested whether females and males had different item-response probabilities by comparing two models at each time point: 1) constraining item-response probabilities to be equal in both females and males; and 2) varying item-response probabilities in males and females at Time 2 (Model 1: BIC = 5372.92 vs. Model 2: BIC = 5452.09), at Time 3 (Model 1: BIC = 5128.68 vs. Model 2: BIC = 5295.27) and Time 4 (Model 1: BIC = 4614.57 vs. Model 2: BIC = 4670.20). Furthermore, we compared two LTA models to examine if female and male had equivalent classes across time by 1) constraining item-response probabilities to be equal to females and males (BIC = 11,853.00) simultaneously across all time points and 2) varying estimation of item-