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Directions of the relationship between substance use and depressive symptoms from adolescence to young adulthood

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HIGHLIGHTS

- Depressive symptoms associated with later increases in smoking for females
- Depressive symptoms associated with later increases in marijuana for males
- Smoking linked with later increases in depressive symptoms, especially in females

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ABSTRACT

Purpose: Both substance use and depression are common in adolescence and often comorbid. Past research has produced conflicting results on whether there is a temporal relationship and if so, in which direction it operates and how it may vary by sex. The purpose of this paper is to explore the longitudinal, potentially bidirectional, relationships between high-frequency substance use and depressive symptoms from adolescence into young adulthood for males and females.
Methods: Using data from the National Longitudinal Study of Adolescent to Adult Health we investigated longitudinal associations between high frequency substance use (alcohol, cigarettes, and marijuana) and depressive symptoms. The linear mixed effects models were stratified by sex and used a lagged measure of the dependent variable to test temporal relationships. A random intercept was used for respondent ID.
Results: Increases in depressive symptoms were significantly associated with a later increase of about a half day in marijuana use frequency for males and nearly a two day increase in smoking frequency for females. Conversely, increases in smoking frequency were significantly associated with approximately a 0.6-point increase for females and 0.4-point increase for males in depressive symptoms at a later wave.
Conclusions: Results indicate a bidirectional relationship between smoking and depressive symptoms for females. For males, there was evidence supporting self-medication with marijuana and for smoking being associated with later increases in depressive symptoms. Results inform how substance use and depression screening, prevention and treatment efforts should be paired and targeted for males and females.

1. Introduction

Substance use and depression are common in adolescence, frequently co-morbid, and have serious short- and long-term health implications (Chassin, Hussong, & Beltran, 2009; Fletcher, 2010; Kann et al., 2014). Despite substantial research, the directionality between the two, and whether directionality varies by sex, remains unclear. The self-medication hypothesis asserts that risk taking is used to ameliorate depressive symptoms possibly through lowering impulse control or motivation (Chassin et al., 2009; Khantzian, 1997). Several studies support this pathway. For example, one study followed over 4000 adolescents from grades 9 to 12 and found those reporting higher depressive symptoms in grade 9 reported faster increases in cigarette and marijuana use (Hooshmand, Willoughby, & Good, 2012). Burns et al. followed a small group of rural adolescents for two years and found baseline depression scores were associated with later tobacco use (Burns et al., 2004). Below we illustrate the mixed findings from research in this area, focusing on papers using advanced longitudinal methods.

Sex complicates the self-medication hypothesis as adolescent females generally report more depression and less risk taking; the

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aforementioned studies did not examine sex differences (Chassin et al., 2009; Kann et al., 2014). Studies examining sex differences show conflicting results. For example, symptoms of depression were positively associated with alcohol, tobacco, and drug use in a clinical sample of 400 youths but relationships were not moderated by sex (Schwinn, Schinke, & Trent, 2012). In contrast, in a sample of ninth and 10th grade students, overall negative mood predicted rapid smoking escalation in boys, but only those with affect-related motives for smoking; for girls, negative mood variability predicted smoking escalations indicating moderation by sex (Weinstein & Mermelstein, 2013). Another study that followed students through high school found an increase in depressive symptoms predicted trying smoking for boys but not for girls (Killen et al., 1997). Similarly, with a sample of over 600 African American adolescents who were interviewed annually for six years starting in high school, depressive symptoms predicted marijuana use in males but not in females (Repetto, Zimmerman, & Caldwell, 2008). However, a small study of 200 undergraduate women found support for self-medication with alcohol (Mushquash et al., 2013).

Some sex differences in self-medication could be due to differences in the substances. A study of cannabis-dependent respondents found cannabis increased depressive symptoms among those with a history of depression though it improved control of aggression, which is more common among males (Arendt et al., 2007; Green & Ritter, 2000; Zahn-Waxler, Shirtcliff, & Marceau, 2008). This may explain findings supporting male self-medication with marijuana (Henry et al., 1993; Repetto et al., 2008; Schuster, Mermelstein, & Wakschlag, 2013). The Nicotine Dependence in Teens study revealed cigarette smoking does not seem to reduce depressive symptoms but can slow rate of change over time (Chaiton, Cohen, O'Loughlin, & Rehm, 2010). As depressive symptoms can be less gender-normative for males, they may have stronger motivations than females to self-medicate and slow symptom progression (Evans, Frank, Oliffe, & Gregory, 2011; Tamres, Janicki, & Helgeson, 2002). Finally, in a sample of 400 eighth grade students, Tomlinson and Brown (2012) found depressive symptoms did predict heavier, more frequent, and solitary drinking but the relationship may be moderated by social anxiety and alcohol expectancies, which may vary by sex (Tomlinson & Brown, 2012).

Alternatively, there is support for the reverse pathway that substance use leads to depression, though results are again mixed. Using data from Waves I and II of Add Health, one study found both sexual risk taking and substance use predicted an increased likelihood of future depression; the self-medication pathway was not supported in their analyses (Hallfors, Waller, Bauer, Ford, & Halpern, 2005). Similarly another study using Add Health data from Waves I and II, found no relationship between depression and later smoking but did find support for the reverse (Goodman & Capitman, 2000). Longitudinal analyses for over 1000 New Zealand youth indicated the best-fitting causal model was from alcohol abuse or dependence to depression, though they tested both directions (Fergusson, Boden, & Horwood, 2009). A longitudinal study of African Americans from age 6 to 42 found increased substance use (alcohol, marijuana, cocaine) in adolescence predicted psychological distress in young adulthood but only for men (Green, Zebrak, Robertson, Fothergill, & Ensminger, 2012). These latter findings conflict with other theoretical and empirical findings indicating females are more vulnerable to increased depression resulting from substance use, perhaps due to their greater interpersonal sensitivity and vulnerability to interpersonal stress (Ge, Lorenz, Conger, Elder, & Simons, 1994; Hallfors et al., 2005; Rudolph, 2002).

Previous studies of the association between depression and substance use in adolescents are limited by cross-sectional design or, when longitudinal, by using non-representative samples, short time periods, or not examining both directions or sex differences (Brook, Brook, Zhang, Cohen, & Whiteman, 2002; Chinet et al., 2006). This paper prospectively examines directionality over a longer time period using the population-based Add Health sample and stratifying by sex. Based on prior research, we hypothesized greater support for the self-medication hypothesis for males and greater support for the reverse pathway for females.

2. Methods

2.1. Sample

Add Health is a school-based longitudinal study that includes a nationally representative U.S. sample of adolescents who were in grades 7–12 in the 1994–95 school year (Wave I). There have been four in-home interview waves since. The analysis sample is restricted to respondents subsequently interviewed at ages 18 to 26 (Waves III, 2001) and ages 24 to 32 (Wave IV, 2007–2009), with valid sampling weights ($N = 12{,}288$) and who had complete data on all variables of interest ($N = 12{,}017$, missing 2.2%). Data from Wave II were not used as Wave I seniors were not followed by design. Details of the Add Health study and design are described elsewhere (Harris, 2013). All Add Health processes were approved by the Institutional Review Board at the University of North Carolina, Chapel Hill, these analyses were deemed exempt.

2.2. Measures

2.2.1. Depression

We used the nine items from the Center for Epidemiologic Studies Depression scale (CES-D) that appeared at each interview wave, as prior Add Health studies have done (alpha = 0.8). The psychometrics of a seven-item CES-D have been previously validated (Levine, 2013). Questions ask about frequency of symptoms in the past week, though 12-month re-test reliability is high (Eaton, Muntaner, Smith, Tien, & Ybarra, 2004). Answers are scored from 0 to 3, indicating rarely to most of the time; the summed score ranges from 0 to 27. The CES-D captures depressive symptoms but is not a diagnostic tool (Eaton et al., 2004).

2.2.2. Substance use

Substances include alcohol (binge drinking), cigarettes, and marijuana. In Add Health, substance use is assessed with either continuous or ordinal variables, and the time frame varies. For cigarette smoking, respondents are asked, at all waves, how many *days* they smoked in the past thirty days. At Waves I and III, the question is very similar for marijuana use but captures *instances* of use in the past 30 days (e.g., 0 to >900). At Wave IV, the question changes to measure how many *days* respondents used marijuana in the past thirty using a 0 to 6 ordinal scale for none to nearly every day or every day. Finally, binge drinking was assessed for the past year using the same ordinal variable (Harris, 2013). To make the measures of marijuana use frequency comparable across the waves, days of marijuana use was derived from the measures at Waves I and III and then these frequencies were made ordinal to align with the measure of marijuana use at Wave IV. We modeled each substance individually controlling for use of the others.

2.2.3. Controls

Substance use and depressive symptoms can vary along sociodemographic lines so covariates were included for respondent's self-identified race/ethnicity (Hispanic and non-Hispanic White, Black, Asian, Native American, and Other) and educational attainment of both the parents and the respondent (less than high school, high school graduate, some college, or college graduate or higher) as a proxy for socioeconomic status (Chassin et al., 2009). Respondent's age was also included as substance use can vary substantially by age and the age ranges are fairly wide within waves.