

## Insufficient Sleep as a Risk Factor for Substance Use Among Adolescents: The Mediating Role of Depressive Symptoms

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**Abstract :** Despite the known deficits in sleep duration among adolescents and the increasing prevalence of substance use behaviors among this group, relatively little is known about how insufficient sleep is related to various substance use behaviors and the underlying mechanisms. Informed by the literature suggesting the predictive role of insufficient sleep for substance use and depressive symptoms, we hypothesized that adolescents who lack sufficient sleep during school nights would report a higher level of depressive symptoms and substance use than their counterparts with sufficient sleep. We also hypothesized that depressive symptoms would explain the association of insufficient sleep with substance use, suggesting that mental health plays an important role as a mechanism between insufficient sleep and substance use. This study used the data drawn from the 2019 Youth Risk Behavior Surveillance System Data, which includes a nationally representative sample of U.S. high school students (N=13,677, 49.4% Female, 9th-12th graders). Self-report measures of insufficient sleep (sleeping <7 h on an average school night), depressive symptoms (yes/no), any past 30-day use of cigarette (yes/no), e-cigarette (yes/no), alcohol (yes/no), and marijuana (yes/no). Among the total sample, 47.9% of students reported that they did not have sufficient sleep on school nights, indicating sleeping less than 7 hours. Regarding depressive symptoms, 36.7% of students reported feeling sad or hopeless almost every day for two weeks or more in a row during the past 12 months. Also, the percentages of students who reported one or more times of cigarette use, e-cigarette use, alcohol use, and marijuana use in the past month were 5.32%, 30.11%, 26.83%, and 21.65%, respectively. For bivariate associations among these study variables, insufficient sleep was positively associated with other variables: depressive symptoms ( $r=.08$ ,  $p<.001$ ), cigarette use ( $r=.03$ ,  $p<.001$ ), e-cigarette use ( $r=.04$ ,  $p<.001$ ), alcohol use ( $r=.07$ ,  $p<.001$ ), and marijuana use ( $r=.08$ ,  $p<.001$ ). After controlling for students' characteristics (i.e., age, gender, race/ethnicity, grades), sleeping less than 7 hours on school nights (vs. sleeping more than 7 hours) was significantly associated with the past 30-day use of alcohol and marijuana, whereas cigarette and e-cigarette uses were not. That is, the students who reported having an insufficient sleep on school nights had higher odds of alcohol (Odds Ratio [OR]=1.15, 95% Confidence Interval [CI]=1.014-1.301) and marijuana use (OR=1.36, 95% CI=1.132-1.543). In a subsequent analysis including depressive symptoms together with insufficient sleep, the association of insufficient sleep with alcohol use (OR=1.13, 95% CI=1.011-1.297) and marijuana use (OR=1.33, 95% CI=1.130-1.521) were attenuated and explained by depressive symptoms. Depressive symptoms significantly increased the odds of alcohol use by 32.2% (OR=1.32, 95% CI=1.131-1.557) and marijuana use by 202.1% (OR=2.02, 95% CI=1.672-2.502). These findings together suggest that insufficient sleep may contribute to increased risks of substance uses among adolescents. The current study also shows that psychological disorders of adolescents play important roles in understanding the association between insufficient sleep and substance use, suggesting insufficient sleep is related to substance use indirectly through depressive symptoms. This study indicates the importance of sleep deprivation among adolescents and screening for insufficient sleep in preventing/intervening in substance use.

**Keywords :** adolescents, depressive symptoms, sleep, substance use

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