

Socioeconomic Status, Depressive Symptoms, and Adolescent Substance Use

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Objective: To determine the relationships among socioeconomic status (SES), depression, and substance use among teenagers. We hypothesized that, among teenagers, substance use was associated with SES in a graded fashion and that depression is a mechanism through which SES affects substance use behaviors.

Design: Linear regression analyses of cross-sectional data from Wave I of the National Longitudinal Study of Adolescent Health (1995).

Participants: Fifteen thousand one hundred twelve adolescents whose parents answered questions assessing household income and parental education.

Main Outcome Measures: Use of cigarettes, alcohol, marijuana, and cocaine.

Results: For all 4 substances, frequency of use varied by SES. In the total population, inverse SES gradients were present for cigarette use (education, mean change = -0.052 ; 95% confidence interval [CI], -0.081 to -0.023 ; income, mean change = -0.038 ; 95% CI, -0.069 to -0.007) and alcohol use (income, mean change = 0.044 ; 95% CI, 0.016 - 0.071). The relationship between marijuana use and education was also significant but inverse-U-shaped, not linear. This relationship was only present among nonwhite teenagers. Race/ethnicity also moderated the relationships between SES and cigarette use and SES and cocaine use. For cigarette

use, stratification by race/ethnicity revealed an inverse graded relationship among white non-Hispanic teenagers and a direct, graded relationship among nonwhite teenagers (ie, mean change for education among white non-Hispanic teenagers, -0.012 ; 95% CI, -0.016 to -0.075 ; mean change for education among nonwhite teenagers, 0.040 ; 95% CI, 0.014 - 0.072). For cocaine use, a weak, inverse linear relationship existed only between education and cocaine use among white non-Hispanic teenagers (mean change for education, -0.013 ; 95% CI, -0.026 to -0.0004). The relationship between the SES indicator and substance use weakened when depressive symptoms were entered into the model for the SES–cigarette use relationship (23% decrease in mean change associated with a 1-unit change in both education and income) and for the association between education and cocaine use among white non-Hispanic teenagers (31% decrease).

Conclusions: Socioeconomic status is associated with substance use among teenagers but the nature of the relationship is not consistent across SES indicators or across race/ethnicity groups. Depressive symptoms are a mechanism through which SES affects cigarette and cocaine use behaviors among teenagers. However, these data indicate that interventions targeted toward decreasing depressive symptoms will not have a strong impact on the effects of SES on teenage substance use.

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ALTHOUGH RESEARCH on infants, young children, and adults indicates that socioeconomic status (SES) is related to health outcomes in an inverse graded fashion,¹⁻¹⁰ research on the sociostructural determinants of adolescent health is sparse.¹¹ This may be in part because adolescents are generally considered a healthy population. However, serious morbidity, such as depression, exists in this age group. Estimates of the prevalence of depression during adolescence range from 15% to 20%.¹² Depression puts adolescents at increased

risk for multiple sequelae that can have long-term effects on many areas of adult functioning.¹² Substance use and abuse are examples of such sequelae. In 1999, 81.0% of US high school students had at least 1 drink containing alcohol and 70.4% had tried cigarettes.¹³ Nearly half (47.2%) had tried marijuana and 9.5% had used cocaine.¹³ Like depression, lower SES has also been associated with increased substance use among adolescents.^{14,15}

The theory of relative deprivation and the work of Wilkinson^{16,17} suggest a model that links the associations among SES, depression, and substance use (**Figure**).

METHODS

DATABASE AND SAMPLE DESCRIPTION

The National Longitudinal Study of Adolescent Health (Add Health) provided the data for this study. Add Health is a recent nationally representative study of in-school teenagers in grades 7 through 12.²¹ Wave I in-home data were collected between April and December 1995. This study included 15112 adolescents whose parents completed information on parental education, household income, or both during the Wave I in-home interview.

DESCRIPTION OF VARIABLES INCLUDED IN ANALYSES

Measures of SES

Income. Parental respondents were asked to report, in thousands of dollars, total 1994 household income before taxes. The ratio of the reported household income to the 1994 federal poverty thresholds (FPT) adjusted for household size was determined. An ordinal 5-level variable was then created using these ratios and 1994 US census data for total household incomes. Categories included less than 1.5 times the FPT, a conservative estimate of poverty; 1.5 to less than 2.5 times the FPT; 2.5 to less than 4 times the FPT; greater than 4 times the FPT but not in the top 5% of US household incomes; and in the top 5% of US household incomes.¹¹

Education. A parent reported self and spouse educational attainment. The higher of these was used to categorize parent education as less than a high school degree; a high school degree or equivalent or vocational training instead of high school;

vocational training after high school or some college; college graduate; and professional training beyond college.

Depressive Symptoms

Depressive symptoms were measured with 18 of the 20 items from the Center for Epidemiologic Studies Depression Scale (CES-D).²² Two of these items had been modified slightly by Add Health. Full CES-D scores were imputed from the 18 available items by using the mean of the scored items to adjust for missing items. Subjects had to complete at least 80% of the available items to be scored. The CES-D was developed to measure symptoms of depression within the community. It is a valid and reliable measure with good internal consistency and test-retest reliability that has been commonly used in the literature as a measure of adolescent mental health.^{23,24} The scores of the CES-D can range from 0 to 60. Among adolescents, scores of 22 or higher among boys and 24 or higher among girls are felt to be predictive of major depressive disorder.²⁴

Substance Use

Measures of alcohol, cigarette, marijuana, and cocaine use were included in this study. Five-point, Likert-type scales were created from the items assessing alcohol, cigarette, and marijuana use from the in-home survey. Cocaine use was assessed on a 4-point scale since use of this substance was limited. Categories assessing frequency of alcohol use in the past 12 months ranged from never to daily. Cigarette, marijuana, and cocaine use scales focused on current use (use in the past 30 days). Measures to assess current alcohol use were not available in Add Health. For cigarette use, items were combined to create the following categories:

Continued on next page

Wilkinson has argued that psychosocial factors may be part of the causal pathway linking SES to health outcomes.¹⁸ Such intermediary factors that link exposure and outcome variables are referred to as mediators.¹⁹ Depression has been identified as one of these potential mediating factors in the SES-health relationship.^{3,20} However, studies examining these associations, especially those focusing on the critical developmental period of adolescence, are rare. The objective of this study, which uses data from a recent nationally representative study, was to determine the relationships among SES, depressive symptoms, and use of 4 commonly used substances—cigarettes, alcohol, marijuana, and cocaine. We hypothesized that, among teenagers, substance use would be associated with SES in a graded, linear fashion and that increased depressive symptoms would be an intermediary factor in the casual pathway linking SES to teenage substance use behaviors (Figure).

RESULTS

A description of the study population and substance use behaviors among these adolescents is presented in **Table 1**. Mean \pm SD age was 15.9 \pm 1.8 years. Mean \pm SD

CES-D score was 11.8 \pm 8.0. Substance use was quite common. Only 31% had never used 1 of the 4 substances. Use of cigarettes was reported most frequently (57%), followed by alcohol use (55%). Few adolescents reported cocaine use. Sixty-seven percent of subjects had tried more than one of these substances and their use was highly correlated (**Table 2**). The correlations among cigarette, alcohol, and marijuana use were nearly identical. Cocaine use was less well correlated with use of these other substances and most highly correlated with marijuana use.

REGRESSION ANALYSES: ASSOCIATIONS BETWEEN SES AND SUBSTANCE USE

Table 3 presents the results of linear regression analyses for the total population and race/ethnicity stratified analyses where appropriate. Inverse gradients were present for both SES indicators and cigarette use. Adolescent use of cigarettes decreased as parental education increased: the mean change was -0.052 (95% CI, -0.081 to -0.023) for each 1-unit increase in category of parental education. Similarly, for each unit increase in household income, average cigarette use decreased (mean

never used, experimented (has never smoked a whole cigarette or has smoked a whole cigarette but not in the past 30 days), smoked in the past 30 days but less than 1 pack per week, smoked at least 1 pack per week but less than 1 pack per day in the past 30 days, and smoked at least 1 pack per day in the past 30 days. For marijuana use, categories ranged from never used to used 6 or more times in the past 30 days. For cocaine use, categories ranged from never to used more than once in the past 30 days.

ANALYTIC STRATEGY

Linear regression was used to assess the relationships between indicators of SES and individual substance use measures, and to determine how adjusting for depressive symptoms would affect that relationship. Socioeconomic status indicators were not run together in a single model because these constructs are currently thought to measure different domains of social status. The literature suggests that these different components of SES act through different pathways to create health differentials. Thus, current recommendations state that these indicators should be modeled separately.²⁵⁻²⁷ First, linear regression models were run to determine the association between the 5-level SES indicator of interest and the individual substance use measure. Socioeconomic status, the exposure of interest in this study, was modeled as both a first-order (linear) and second-order (quadratic) term to ensure that a linear gradient rather than a curvilinear effect best described the noted relationship. We next tested for potential interactions between SES and depressive symptoms, age, sex, and race/ethnicity. Significant interactions were found for race/ethnicity only. Analyses stratified by race/ethnicity were performed in these instances.

Once a linear, graded relationship was established between an SES indicator and use of a particular substance,

the effect of depressive symptoms was assessed by adding CES-D scores to the model. If depression were part of the causal pathway linking SES with substance use, the addition of depressive symptoms to the regression model would cause a weakening of the effect of the SES indicator. Such a change reflects mediation. Mediation is commonly measured by the amount (percentage) that the mean estimated change in the predictor variable moved toward zero when the potential mediator (depressive symptoms) was added to the regression model.¹⁹ A change of 10% or more is considered indicative of partial mediation.²⁸

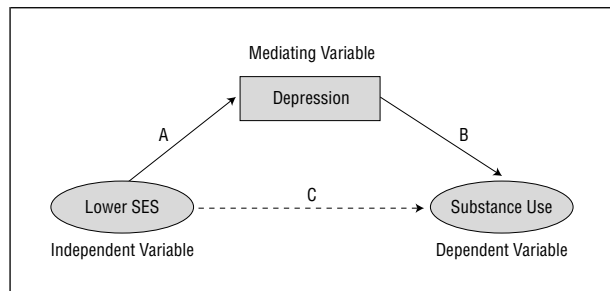
For all regression models, we report the mean estimated change in average substance use category that was found for each 1-unit increase in either category of household income or parental education. Ninety-five percent confidence intervals (CIs) are also reported for these estimates. A positive estimate for the mean change represents direct relationships in which lower SES is associated with decreased substance use and higher SES with increased use. Negative estimates of mean change represent inverse relationships in which lower SES is associated with increased substance use and higher SES with decreased use. Analyses were performed using SUDAAN (Research Triangle Institute, Research Triangle Park, NC) to account for design effects.²⁹ Sample weights were used to account for the complex sampling frame of Add Health. Analyses controlled for other determinants of depression and substance use that could confound the relationships. These included race/ethnicity (white non-Hispanic vs nonwhite teenagers, defined as teenagers belonging to all other racial/ethnic categories), age (in years), family structure (2 parents in the home vs other), alcoholism in the mother or father, and US acculturation (immigrant, first generation, second generation or higher).¹² Means are reported with SDs and all percentages are weighted.

change, -0.039 ; 95% CI, -0.070 to -0.008). However, this inverse relationship was moderated by race/ethnicity. The inverse gradient remained among white non-Hispanic teenagers but not among nonwhite teenagers. Among nonwhite teenagers, a significant, albeit less powerful, direct relationship was present. For these teenagers, an increase in 1 unit of either SES indicator was associated with increased cigarette use (education mean change, 0.040 [95% CI, 0.014 - 0.065]; income mean change, 0.062 [95% CI, 0.017 - 0.107]). Alcohol use was associated only with income in a direct, positive fashion. Marijuana use was significantly associated with education only. This relationship was not linear but inverse-U-shaped, with those in the middle of the income gradient showing the highest rates of use. In stratified analyses, this inverse-U-shaped relationship was present only for nonwhite teenagers. Among white non-Hispanic teenagers, no significant relationship between education and marijuana use was found. Cocaine use was not significantly associated with either SES indicator in the total population. However, a significant interaction between education and race/ethnicity was present. In stratified analyses, a weak, inverse relationship was demonstrated for white non-Hispanic teenagers only, which suggested that for each

category increase in parental education, cocaine use decreased on average by -0.013 categories of use (95% CI, -0.026 to -0.0004).

MEDIATIONAL ROLE OF DEPRESSIVE SYMPTOMS IN DEMONSTRATED SES-SUBSTANCE USE GRADIENTS

Table 4 presents results of regression models that included depressive symptoms. These models were run only for the significant linear associations presented in Table 3. In the total population, these analyses suggested partial mediation for the association between education and cigarette use. The effect of parental education on cigarette use decreased 23.1% with the addition of depressive symptoms to the model. Partial mediation was also present for the income-cigarette use relationship, which showed a 23.7% decrease in the mean change effect. In addition, among white non-Hispanic teenagers, the association between parental education and cocaine use seemed to be partially mediated by depressive symptoms. A 30.7% weakening of the effect of education on cocaine use among white non-Hispanic teenagers was demonstrated.



Mediational model of the socioeconomic status (SES)–substance use relationship by depression. Paths A and B represent the indirect effects of SES on substance use that are mediated by depression. Path C represents the residual direct effect of SES on substance use.

COMMENT

The purpose of this study was 2-fold. We sought to determine if SES gradients in cigarette, alcohol, marijuana, and cocaine use were present among US adolescents and to assess whether depressive symptoms played a mediating role in these relationships. Socioeconomic status was associated with use of all 4 substances but the relationship was not consistent across SES indicators or across race/ethnicity groups, and the direction and shape of the relationship changed among substances and among SES indicators. Prior work has suggested that marijuana is related to SES in a nonlinear fashion.³⁰ Our data confirm this finding. The relationship between parental education and level of marijuana use, present only among nonwhite teenagers, was an inverse U shape. All other relationships between SES level and substance use categories were linear, as hypothesized.

The linear relationship between level of SES and use of a particular substance was most consistent for cigarette smoking, which was related to both income and education. However, the direction of the effect of SES on cigarette use differed between white non-Hispanic teenagers and nonwhite teenagers. Among white non-Hispanic teenagers, an inverse SES gradient was present, which was consistent with the prior reports.^{14,15} In contrast, among nonwhite teenagers, a direct relationship was demonstrated, indicating that higher SES was associated with increased cigarette use. This finding contradicts that of the Third National Health and Nutrition Examination Survey, which indicated that increased education was associated with decreased cigarette use among both Mexican American and black youth. We also found a direct relationship between income and alcohol use in contrast to data from the 1992 National Health Interview Survey.¹⁴ Some of these contradictions may be due to different means of measuring SES and use of these substances. In this study, we examined a wider spectrum of behaviors related to the use of each substance and a broader gradient in education. We also used a measure of household income that was adjusted for household size, which may better reflect disposable income.

Parental education was more consistently associated with use of these substances than household income. These inconsistencies support the idea that SES is a multidimensional construct.^{26,31} Many studies include only a single measure of SES and generalize these effects.

Table 1. Description of the Study Sample

	Unweighted No. (%)
Race	
White, non-Hispanic	8532 (56.7)
Nonwhite, Hispanic	6509 (43.3)
Parent education	
<High school	1601 (11.2)
High school or equivalent	3585 (25.0)
Some schooling after high school but not college graduate	4381 (30.6)
College graduate	2567 (17.9)
Professional training beyond college	2173 (15.2)
Household income	
<1.5 × poverty threshold	3828 (28.9)
1.5 to <2.5 × poverty threshold	3171 (24.0)
2.5 to <4 × poverty threshold	3372 (25.5)
≥4 × poverty threshold but not top 5%	2355 (17.8)
Top 5% of US households	501 (3.8)
Alcohol use	
Never	6724 (44.6)
<Monthly in past year	3917 (26.0)
Monthly in past year	3029 (20.1)
Weekly in past year	1275 (8.4)
Daily in past year	139 (0.9)
Cigarette use	
Never tried	8587 (58.3)
Experimented	2465 (16.7)
Use in past 30 d, <1 pack/wk	2000 (13.6)
Use in past 30 d, >1 pack/wk but <1 pack/d	1345 (9.2)
Use in past 30 d, ≥1 pack/d	326 (2.2)
Marijuana use	
Never used	10 840 (73.1)
Used but not in the past 30 d	1918 (12.9)
Once in the past 30 d	548 (3.7)
2-5 times in the past 30 d	762 (5.1)
≥6 times in the past 30 d	757 (5.1)
Cocaine use	
Never	14 446 (96.9)
Used but not in the past 30 d	286 (1.9)
Once in the past 30 d	96 (0.6)
More than once in the past 30 d	74 (0.5)

Table 2. Spearman Rank Correlations Among Use of Cigarettes, Alcohol, Marijuana, and Cocaine in Adolescents in Wave I Add Health*

	Cigarette Use	Alcohol Use	Marijuana Use	Cocaine Use
Cigarette use	1.00	0.52†	0.51†	0.18†
Alcohol use	...	1.00	0.50†	0.17†
Marijuana use	...	...	1.00	0.29†
Cocaine use	...	...	...	1.00

*N = 15 112. Add Health indicates National Longitudinal Study of Adolescent Health; ellipses, not applicable. †P<.001.

These data highlight the importance of separating the effects of income, education, and other components of SES, such as occupation and perceived social status.³²

There are limitations that must be acknowledged. Although mostly drawn from existing surveys, such as the Youth Risk Behavior Survey, many measures in Add Health have not been validated. Because it is a school-

Table 3. Linear Regression Analyses Assessing the Associations Between SES and Substance Use Among Adolescents in the National Longitudinal Study of Adolescent Health, Stratified by Race/Ethnicity Where Appropriate*

	Total	White, Non-Hispanic	Nonwhite
Cigarettes			
Education	-0.052 (-0.081 to -0.023)	-0.12 (-0.165 to -0.075)	0.040 (0.014-0.065)
Income	-0.039 (-0.070 to -0.008)	-0.088 (-0.131 to -0.045)	0.062 (0.017-0.107)
Alcohol			
Education	0.014 (-0.013 to 0.041)	...	...
Income	0.044 (0.016-0.071)	...	...
Marijuana			
Education	0.178† (0.049-0.307)	-0.018 (-0.253 to 0.217)	0.29† (0.139-0.441)
Income	-0.0042 (-0.037 to 0.045)		
Cocaine			
Education	-0.0047 (-0.013 to 0.004)	-0.013 (-0.026 to -0.0004)	0.0061 (-0.004 to 0.017)
Income	0.0009 (-0.010 to 0.012)		

*Data are given as mean change (95% confidence interval). N = 15 112. All models were adjusted for age, family structure, parental alcoholism, and acculturation. Total population models were also adjusted for race/ethnicity. Stratified analyses were presented when significant interaction term between socioeconomic status (SES) and race/ethnicity was found.

†Inverse U-shaped relationship was revealed in testing of second-order (SES × SES) term. No testing for mediation was performed.

Table 4. Linear Regression Analyses Including Depressive Symptoms in the Models That Assess the Associations Between SES and Substance Use Among Adolescents in the National Longitudinal Study of Adolescent Health*

	Total	White, Non-Hispanic	Nonwhite
Cigarettes			
Education	-0.040 (-0.069 to -0.010)	-0.110 (-0.153 to -0.067)	0.048 (0.024-0.072)
Income	-0.029 (-0.060 to -0.002)	-0.075 (-0.118 to -0.032)	0.067 (0.022-0.112)
Alcohol			
Income	0.049 (0.022-0.076)	...	...
Cocaine			
Education	...	-0.009 (-0.022 to 0.004)	...

*Data are given as mean change (95% confidence interval). N = 15 112. All models were adjusted for age, family structure, parental alcoholism, and acculturation. Total population models were also adjusted for race/ethnicity. Stratified analyses were presented when significant interaction term between socioeconomic status (SES) and race/ethnicity was found.

What This Study Adds

The SES gradient in health is well established but not well understood. Little research has focused on the effects of SES on health during adolescence, a critical developmental period when important biological, psychological, and social transitions occur.

Indicators of SES were associated with cigarette, alcohol, marijuana, and cocaine use but the associations differed across SES indicators. Parental education was more consistently associated with substance use than household income. Race/ethnicity was an important moderating factor for many of these associations. This study provides evidence that depressive symptoms are part of the causal pathway linking SES to adolescent substance use behaviors but suggests that the mediating effects of depressive symptoms are not strong.

based study, teenagers who are no longer in school—a group that is at high risk for increased substance use and increased depressive symptoms and likely to be of lower SES—would not be eligible for the in-home survey. Although the literature suggests that depression is causally related to the outcomes assessed here, these data are

cross sectional and cannot determine whether the substance use led to the increased depressive symptoms in these adolescents or whether prior episodes of depression were important in the genesis both current depressive symptoms and substance use. In addition, no physiologic markers of substance use were collected.

These data suggest that depressive symptoms act as a partial mediator for some relationships between SES and level of substance use among teenagers. However, this mediating role was neither consistent nor powerful. Thus, our findings indicate that interventions targeted toward improving depressive symptoms among adolescents may not have a strong impact on decreasing the effects of SES on adolescent substance use.

One of the more perplexing findings in this study was the change in the direction of the association between SES and cigarette use between white non-Hispanic and nonwhite teenagers. Among white non-Hispanic teenagers, higher SES was associated with decreased cigarette use, while the reverse was true among nonwhite teenagers. Race/ethnicity is often confounded with SES. However, the relationships among race/ethnicity, SES, and health are highly complex. In fact, the association between SES and the use of 3 of the 4 substances studied here was different between white non-Hispanic and nonwhite teenagers. Our analyses suggest that

the effect of parental education and household income on adolescent substance use varies by racial/ethnic group. Studies assessing racial/ethnic differences in health as well as those addressing socioeconomic inequalities in health will need to assess for potential interactions between these 2 critical social forces to improve understanding of how sociostructural factors create health disparities.

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