Ethnic Differences in Adolescent Substance Initiation Sequences

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Objectives: To evaluate ethnic differences in the initiation sequences of tobacco, alcohol, marijuana, and cocaine use among US high school students and to determine if ethnicity is a predictor of progression from licit to illicit substances or initiation of illicit substances before licit substances.


Setting: US high schools.

Participants: A total of 8550 high school students randomly selected by cluster design.

Main Outcome Measures: Respondents were categorized based on self-reported sequence of initiating substances as follows: none, licit substances only, licit substances then illicit substances (typical), illicit substances first (reverse), and licit and illicit substances at the same time (concurrent).

Results: Adjusting for age, maternal education, and region, progression from licit to illicit substances was significantly associated with black ethnicity (odds ratio [OR], 1.5; 95% confidence interval [CI], 1.04-2.1) and male sex (OR, 1.4; 95% CI, 1.2-1.6). Black male and Latino female students whose mothers completed at least high school were more likely than white students with similarly educated mothers to initiate illicit substances before licit substances (OR, 3.0; 95% CI, 1.7-5.3; and OR, 5.9; 95% CI, 1.7-20; respectively). Similar trends were noted for the concurrent sequence.

Conclusions: The pattern of initiating tobacco, alcohol, marijuana, and cocaine use differs by ethnicity. Maternal education may be a proxy variable for other significant risk factors.


SUBSTANCE USE can interfere with normal cognitive and psychological development and is associated with poor decision making,1 poor educational and job performance, problematic relationships, and economic instability.2 Many of the behaviors initiated during adolescence continue into adulthood.3,4 As such, examining substance abuse patterns and their correlates in high school students is an important public health priority.

Understanding the differences in prevalence rates of substance initiation patterns may foster the development of more effective interventions. Several studies5,7 have concluded that definite sequences of substance use exist. At least 4 stages were identified by Kandel et al.5 through a longitudinal prospective study of New York high school students: (1) beer or wine, (2) cigarettes or hard liquor, (3) marijuana, and (4) other illicit drugs. Most adolescents went through 2 stages of licit drugs between non-use and marijuana. Few students in this study progressed to illicit drugs without initiating marijuana use. Seventy-five percent of the high school students who used both licit and illicit substances progressed along the following sequence: nonuse, legal drugs, marijuana, pills (methamphetamine, other amphetamines, barbiturates, or tranquilizers), psychedelics, cocaine, and heroin.5 A longitudinal study6 of subjects from 13 to 24 years of age showed that, in general, alcohol and tobacco use begins at earlier ages than marijuana and cocaine use.

Several studies7,7,8 have demonstrated that tobacco is a gateway drug to marijuana use. However, this appears less likely among African American students, who tend to have a low prevalence of tobacco use and a high prevalence of marijuana use.7,8 Data from the Centers for Disease Control and Prevention’s 1995 Youth Risk Behavior Survey (YRBS) demonstrate a difference in the age of drug use initiation by ethnicity. For example, white
(25.9%) and Latino (26.6%) students were significantly more likely than African American students (17.2%) to have initiated smoking by 13 years of age.9 Latino students (39.5%) were significantly more likely than white students (30.3%) to have initiated alcohol use before 13 years of age. African American (11.1%) and Latino (12.6%) students were significantly more likely than white students (5.6%) to have initiated marijuana use before 13 years of age. African American (1.3%) and Latino (1.7%) students were more likely than white students (0.9%) to have initiated cocaine use before 13 years of age.9

Substance initiation sequences may be due to the effect of one type of drug on the use of another, the relationships between the use of the substances and the user’s demographic, psychosocial, and environmental characteristics, or a combination of both. The period of risk for initiation of cigarettes, alcohol, and marijuana use is completed by the age of 20 years and for most illicit drugs by the age of 21 years.9 The younger the age of onset of legal drug use, the more subjects are at risk of initiating use of an illicit substance.10 Higher prevalence rates of substance use are associated with increasing age.7,11 Sex differences in substance initiation patterns have also been noted. Most men progress along the following sequences: alcohol preceding marijuana and alcohol and marijuana preceding other illicit drugs.12 Most women follow sequences such as alcohol or cigarettes preceding marijuana and alcohol, cigarettes, and marijuana preceding other illicit drugs.12 Parental education may play a role on the adolescent initiation sequence indirectly, since low educational attainment is associated with substance use in adults13 and access to substances in the home is associated with use of tobacco, alcohol, and marijuana among high school students.14 Thus, in examining substance initiation sequences, it would be important to adjust for age, sex, and parental education.

Although attention has been given to substance initiation sequences, few studies have examined differences in these sequences by ethnicity. Most studies16,12,15,16 have examined only one ethnic group, compared differ-
sequence types initiated substance use with illicit drugs. This new sequence was labeled the reverse sequence.

Age at the time of questionnaire administration was categorized as 14 years or younger, 15 years old, 16 years old, 17 years old, and 18 years or older. Ethnicity was obtained from the question, “How do you describe yourself?” The allowable choices included “white—not Hispanic, black—not Hispanic, Hispanic or Latino, Asian or Pacific Islander, American Indian or Alaskan Native, other.” The other, Asian or Pacific Islander, and American Indian or Alaskan Native choices were too small for meaningful interpretation and thus not included in the results.

Maternal education was used as an indirect measure of socioeconomic status. Information on paternal education was requested, but 768 more responses were “not sure” compared with the answers for maternal education. Maternal education was grouped into 4 categories, which were then collapsed into “less than high school” and “high school or more.”

Because prior literature showed some differences in substance use across geographic regions,11,17,18 we controlled for region, with the region variable categorized as Northeast, Midwest, South, and West.

STATISTICAL ANALYSIS

All analyses were performed using the statistical package Stata.22 Stata allowed precise estimation of confidence intervals (CIs) that accounted for the 3-stage cluster-sampling scheme. Subjects with missing data were excluded from the analysis. The demographic characteristics, substance initiation ages, and past month substance use of the excluded subjects were compared with those of included subjects using the F statistic, adjusting for the 3-stage cluster sample design. Significance was defined at an a level of .05. Tables were constructed to examine the crude association between sequence and ethnicity, age, sex, maternal education, and region. To answer the first research question (“Among students who start using licit substances, what characteristics are associated with progression to illicit substances?”), only the subjects who belonged to either the licit only or typical sequence were analyzed, using logistic regression with a binary outcome (n=5887). In this model, age had a linear relationship with the log odds of sequence. The other main effects—sex, ethnicity, maternal education, and region—were entered as categorical variables. All 2-way interactions involving ethnicity, sex, age, region, and maternal education were tested using the Wald test. None were statistically significant (P>.05).

To answer the second research question (“Among students who have used licit and illicit substances, what characteristics are associated with initiation of illicit drugs first?”), only the subjects who had used both licit and illicit substances were included in the analysis. Because there were more than 2 possible outcomes (typical, reverse, and concurrent sequences), polytomous logistic regression was used to generate a set of logistic models that compared relevant pairs of outcomes. In our case, the relevant outcome pairs were the reverse sequence vs the typical sequence and the concurrent sequence vs the typical sequence. The relationship of the reverse and concurrent sequences to ethnicity controlling for sex, age, maternal education, and region was examined in this manner. The study population included 4473 observations. The outcome variables reference group was the typical sequence. Sex, ethnicity, age, maternal education, and region were all indicator variables with female, white, 18 years or older, high school education or more, and Northeast used as the covariate reference groups, respectively. However, the regions were arbitrarily assigned after the data were collected and therefore the results for region may not offer any meaningful information. Several models were compared using the F statistic. Again, 2-way interactions involving ethnicity, sex, age, region, and maternal education were tested using the Wald test. Significant interaction terms between ethnicity and sex and between ethnicity and maternal education were found.

RESULTS

The school response rate was 70%, and the student response rate was 86%, making the overall response rate 60% (0.70 x 0.86).

There were 10904 respondents to the 1995 YRBS. Respondents who did not report their age at first use of tobacco, alcohol, marijuana, or cocaine or any of the other questions involved in the analysis were excluded, leaving a sample of 8550 subjects. Table 1 shows the demographic characteristics of the excluded and included subjects. Among the 8550 participants in the study, 75% were white, 14% were African American, and 11% were Latino. Approximately 49% of the subjects were female, and 86.4% of the students’ mothers had at least a high school education. The included and excluded groups were not significantly different in the demographic characteristics (Table 1). However, the included and excluded groups were significantly different in the age they first initiated marijuana use (P=.006) and the use of alcohol and marijuana in the past 30 days (P<.001 and .006, respectively). Included subjects were somewhat more different countries, or compared whites with nonwhites or African Americans. Given the different prevalence, initiation rates, and risk factors of substance use among African American, Latino, and white high school students,11,17,18 there may be important differences in the substance initiation sequences by ethnicity as well.

We analyzed the YRBS data to answer the following questions about ethnic differences in substance initiation sequences: (1) Among students who start using licit substances, what characteristics are associated with progression to illicit substances? (2) Among students who have used licit and illicit substances, what characteristics are associated with initiation of illicit drugs first?

This study provides a preliminary examination of initiation sequences for the most commonly used licit and illicit substances among high school students: tobacco, alcohol, marijuana, and cocaine. The objective is to identify subgroups at risk for a particular drug sequence to help design more targeted and effective preventive programs.
likely than excluded subjects to have reported a history of ever using marijuana (44%; 95% CI, 40%-48%; vs 37%; 95% CI, 32%-42%). Included subjects were more likely than excluded subjects to have started using marijuana at 13 to 14 years of age and 17 years or older, and the excluded group was more likely than the included group to have not used marijuana or alcohol in the past 30 days (data not shown).

Table 2 provides the definition and weighted percentage of each sequence among US high school students in 1995. The most common sequences were the licit only (39.4%) and typical sequences (30.9%).

Table 3 and Table 4 summarize the weighted prevalences and weighted unadjusted odds ratios (ORs), respectively, of each sequence by ethnicity, sex, and maternal education. The weighted unadjusted ORs by characteristic were calculated using univariate polytomous logistic regression. The reference group was the typical sequence. According to this model, progression to illicit substance use (given that a student already initiated licit substance use) was significantly associated with progression from licit to illicit drugs. Interaction terms between ethnicity and sex, ethnicity and age, and ethnicity and maternal education were not statistically significant. Age had a linear relationship with the log odds of the typical and licit only sequences. According to this model, progression to illicit substance use (given that a student already initiated licit substance use) was significantly associated with African American ethnicity (OR, 1.5; 95% CI, 1.04-2.1), male sex (OR, 1.4; 95% CI, 1.2-1.6), and age (OR, 1.2; 95% CI, 1.02-1.3). Having a mother with a high school education was not a significant predictor of progression from licit to illicit substances. Latino ethnicity also was not associated with progression from licit to illicit drugs.

The results of the multivariate polytomous logistic regression analysis are presented in Table 6 and Table 7. Table 6 shows the weighted, adjusted, stratum-specific ORs for the concurrent sequence compared with the typical sequence. African American students were more likely than white students to follow the concurrent sequence when their mothers had at least a high school education. This association was observed in both sexes (boys: OR, 2.4; 95% CI, 1.5-3.7; girls: OR, 3.0; 95% CI, 1.7-5.3). Latino girls whose mothers had at least a high school education were more likely to follow the concurrent sequence than white girls whose mothers had the same level of education (OR, 1.9; 95% CI, 1.2-3.1).

Table 7 shows that African American male students whose mothers had at least a high school education were 2.2 times more likely to follow the reverse sequence and 1.7 times more likely to follow the concurrent sequence than students whose mothers had at least a high school education.

Table 5 illustrates the factors that were independently associated with proceeding to illicit substance use among students who were already using licit substances. Interaction terms between ethnicity and sex, ethnicity and age, and ethnicity and maternal education were not statistically significant. Age had a linear relationship with the log odds of the typical and licit only sequences. According to this model, progression to illicit substance use (given that a student already initiated licit substance use) was significantly associated with African American ethnicity (OR, 1.5; 95% CI, 1.04-2.1), male sex (OR, 1.4; 95% CI, 1.2-1.6), and age (OR, 1.2; 95% CI, 1.02-1.3). Having a mother with a high school education was not a significant predictor of progression from licit to illicit substances. Latino ethnicity also was not associated with progression from licit to illicit drugs.

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substance use before licit substance use than white high school girls with the same maternal education (OR, 5.9; 95% CI, 1.7-20).

Expressed in another way, white students whose mothers did not graduate from high school were more likely than white students whose mothers completed high school to follow the concurrent and reverse sequences relative to the typical sequence (OR, 2.1; 95% CI, 1.2-3.8; and OR, 3.7; 95% CI, 1.3-10.4, respectively). By contrast, maternal education was not associated with the sequence of substance use initiation among African American (concurrent sequence: OR, 1.0; 95% CI, 0.5-2.0; reverse sequence: OR, 1.1; 95% CI, 0.2-7.4) and Latino students (concurrent sequence: OR, 1.6; 95% CI, 0.4-6.2; reverse sequence: OR, 1.0; 95% CI, 0.4-2.8).

**Table 3. Frequencies and Weighted Percentages of Substance Initiation Sequences by Demographic Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>None</th>
<th>Licit Only</th>
<th>Typical</th>
<th>Concurrent</th>
<th>Reverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>599</td>
<td>1710 (41.9)</td>
<td>1390 (31.2)</td>
<td>418 (9.6)</td>
<td>54 (1.6)</td>
</tr>
<tr>
<td>Black</td>
<td>572</td>
<td>960 (29.6)</td>
<td>805 (26.8)</td>
<td>496 (18.7)</td>
<td>130 (4.1)</td>
</tr>
<tr>
<td>Latino</td>
<td>316</td>
<td>818 (34.7)</td>
<td>496 (18.7)</td>
<td>130 (4.1)</td>
<td>60 (3.1)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>906</td>
<td>2030 (42.0)</td>
<td>1285 (28.0)</td>
<td>612 (12.0)</td>
<td>97 (2.0)</td>
</tr>
<tr>
<td>Male</td>
<td>688</td>
<td>1661 (37.0)</td>
<td>1659 (33.0)</td>
<td>639 (12.0)</td>
<td>166 (3.0)</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High school</td>
<td>258</td>
<td>616 (33.0)</td>
<td>478 (31.0)</td>
<td>244 (18.0)</td>
<td>60 (4.0)</td>
</tr>
<tr>
<td>≥High school</td>
<td>1127</td>
<td>2725 (41.0)</td>
<td>2167 (31.0)</td>
<td>860 (10.0)</td>
<td>169 (2.0)</td>
</tr>
</tbody>
</table>

**Table 4. Weighted Unadjusted Odds Ratios for Specific Substance Initiation Sequences, by Demographic Characteristic, Using Typical Sequence as Reference Group**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>None</th>
<th>Licit Only</th>
<th>Concurrent</th>
<th>Reverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White†</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Black</td>
<td>1.5</td>
<td>0.8 (0.6-1.1)</td>
<td>2.3 (1.6-3.3)</td>
<td>3.0 (1.9-4.7)</td>
</tr>
<tr>
<td>Latino</td>
<td>0.8</td>
<td>0.8 (0.5-1.1)</td>
<td>1.4 (1.1-2.0)</td>
<td>1.8 (1.1-3.0)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female†</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Male</td>
<td>0.8</td>
<td>0.8 (0.6-0.9)</td>
<td>0.8 (0.7-1.1)</td>
<td>1.6 (0.9-2.8)</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High school</td>
<td>0.9</td>
<td>0.8 (0.6-1.02)</td>
<td>1.7 (1.04-2.9)</td>
<td>2.2 (1.1-4.3)</td>
</tr>
<tr>
<td>≥High school†</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Odds ratios were derived from the regression coefficient and SE in univariate polytomous logistic regression models that contained the respective characteristic as the only independent variable.
† Reference group.
‡P<.05.

Consistent with prior literature, we found that African American ethnicity, male sex, and increasing age were associated with progression from licit to illicit substance use. We also found, in unadjusted analyses, that African American and Latino students were more likely than white students to follow the concurrent or reverse sequences (relative to the typical sequence). However, closer study revealed that these differences were entirely limited to students whose mothers had graduated from high school. There were no ethnic differences in substance initiation patterns among students whose mothers had less education. This finding has not been previously reported.

**Table 5. Factors Associated With Progression to Illicit Substances Once Licit Substances Are Initiated**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
<th>SE of the Estimate</th>
<th>Weighted Adjusted Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black vs white†</td>
<td>0.382</td>
<td>0.168</td>
<td>1.5 (1.04-2.1)†</td>
</tr>
<tr>
<td>Latino vs white†</td>
<td>0.123</td>
<td>0.193</td>
<td>1.1 (0.8-1.7)</td>
</tr>
<tr>
<td>Male vs female†</td>
<td>0.324</td>
<td>0.068</td>
<td>1.4 (1.2-1.6)†</td>
</tr>
<tr>
<td>Age (1 y)</td>
<td>0.143</td>
<td>0.062</td>
<td>1.2 (1.02-1.3)†</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High school</td>
<td>0.268</td>
<td>0.161</td>
<td>1.3 (0.9-1.8)</td>
</tr>
<tr>
<td>High school</td>
<td>0.198</td>
<td>0.100</td>
<td>1.2 (0.99-1.5)</td>
</tr>
<tr>
<td>&gt;High school</td>
<td>0.156</td>
<td>0.098</td>
<td>1.2 (0.96-1.4)</td>
</tr>
</tbody>
</table>

* Controlling for region.
† Reference groups.
‡P<.05.
Maternal education may be a proxy variable for other environmental and cultural factors and may represent different markers for each ethnicity. Several studies have found that more acculturated Latinos have higher prevalences of substance use than recent immigrants. Perhaps more acculturated students have parents with higher education. As such, the findings for Latino female students may indicate that more acculturated female students are at higher risk for initiating illicit substance use than less acculturated female students. Further studies that include acculturation scales, country of birth, and language are needed to clarify the interpretation of the results. It is unlikely that maternal education represents acculturation among white students. In the comparison between African American and white students, maternal education may not represent the same marker either. Maternal education may represent other sociopolitical factors based on the different group experiences and histories in the United States. Further studies that include students’ experiences, outlook of the future, feelings of disenfranchisement, and parental influences are needed to delineate a better understanding of the difference seen in maternal education among the African American students.

In interpreting the results of the study, several limitations must be recognized. First, this is a cross-sectional study. Causal relationships cannot be determined. Second, these data may not reflect the true prevalence of substance use in the study population because of the respondents’ desire to give socially acceptable answers and problems with recall. However, we doubt that these factors would differ across ethnic groups, so our ethnic comparisons should be unbiased. Third, the concurrent sequence assumes that the student initiated use of both licit and illicit substances at the same time. However, within this category, there could be students who followed the typical or reverse sequences because of the 2-year age spans in the allowable responses for the substance initiation questions. If each ethnic group accounted for a different proportion of misclassified sequences, the resulting differential misclassification could bias the results. Future studies should attempt to ascertain more precisely when use of each substance was initiated.

The relationship between ethnicity and substance sequence may be different for students who participated in the YRBS and those who did not participate or were excluded because of missing data. The characteristics of the included and excluded groups varied significantly at several levels. In general, the excluded group consisted of significantly more students with younger marijuana use initiation ages and those who never used marijuana. The included group may have fewer never users of alcohol and marijuana in the past 30 days than the excluded group, since the latter group had no sequence of substance use. The differences among the groups may have contributed to biased results. Also, we have no information on substance use among nonrespondents to the questionnaire. The overall response rate was only 60%, which could have contributed to selection bias. The adolescents who were not in the study could have included those who refused consent, had parents who refused consent, were truant, dropped out of school, ran away, or were homeless. These adolescents may be more likely to use substances or may tend to follow different initiation sequences than those at school. As such, the generalizability is limited to students enrolled in and attending high school. In addition, the use of a high school stu-
dent data set may bias our results. Adolescents who drop out of school may be more likely to have parents who did not graduate from high school. Students who dropped out of school may also be more likely to be involved with substance abuse or associated high-risk behaviors than the students enrolled in school. Thus, our stratum-specific ORs may be biased, because the students who are most at risk and who have mothers with low educational attainment may not be fully represented in the sample. Further studies including adolescents not in school are needed to clarify these issues.

Finally, the data set does not allow for control of likely confounders that might influence the initiation of substance use. Such confounders include socioeconomic status, neighborhood and school characteristics, perceived peer pressure, family characteristics, peer norms, and substance availability. In view of these limitations, future studies should collect longitudinal prospective data on psychosocial, biological, and environmental factors and should include adolescents who are not enrolled in school. In addition, larger subsample sizes to study Asians, American Indians, and subgroups of each ethnicity would contribute to a better understanding of the association between ethnicity and substance initiation sequences.

Our study shows that African American students and Latino female students were more likely than whites to initiate illicit substance use at the same time as or before licit substances when their mothers had graduated from high school. As such, this subset of Latino and African American students may not follow the usual pathway of substance initiation that has been previously described in the literature. Maternal education appears to modify the effect of ethnicity on adolescent substance initiation sequences. Further studies are needed to understand the reasons for this phenomenon and the true markers of maternal education for each ethnic group. Despite the limitations of this study, our results indicate that cultural and family characteristics are important to consider in understanding adolescent substance initiation patterns. Further studies on cultural characteristics of substance use could provide new information to improve recognition of populations at risk in the clinical setting and to improve interventions and prevention programs for adolescents from diverse backgrounds.

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