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Measuring Liability for Substance Use Disorder among College Students: Implications for Screening and Early Intervention

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Abstract

Background—Heavy drinking and illicit drug use among college students has been a longstanding public health concern. Current methods to screen and identify college students at-risk for the development of substance use disorders (SUD) are somewhat limited.

Objectives—This study aimed to cross-validate the work by Kirisci et al., (1) who developed the Transmissible Liability Index (TLI), by deriving a set of items that would be potentially useful for characterizing SUD risk across multiple dimensions among college students. We examined: 1) variations in the TLI-college version (TLI-CV) by race, sex, SES, religiosity, and family history of substance use problems; 2) the association between the TLI-CV and alcohol and/or marijuana dependence, both cross-sectionally and prospectively, by race and sex; and, 3) the sensitivity and specificity of the TLI-CV for identifying cases of marijuana and/or alcohol dependence.

Methods—Data from an ongoing longitudinal study of college students ($n=1,253$) was used to conduct item response theory (IRT) analyses which resulted TLI-CV, comprised of 33 items.

Results—The TLI-CV was significantly associated with baseline dependence and significantly higher for non-dependent individuals who later became dependent during the subsequent three years of college. These associations were observed for both sexes, Whites, Blacks/African-Americans, Asians, and other racial minorities. The sensitivity and specificity were sub-optimal.

Conclusions and Scientific Significance—The TLI-CV advances prior research to identify college students at risk for SUD. This approach holds potential promise to identify and ultimately modify the trajectories of college students who may be at risk for the development of SUD.

INTRODUCTION

Heavy alcohol consumption and illicit drug use during college are associated with significant adverse effects on the health, well-being and safety of young adults (2–4). Epidemiologic trend data on college students show that the proportion classified as “binge drinkers” has remained around 40% over the last two decades (5) and past year marijuana use has remained stable around 30% since 1990. Recently, it has been estimated from national data that 20.6% of full-time college students meet DSM-IV criteria for an alcohol use disorder (AUD) and 7.9% meet criteria for a drug use disorder (6). Similarly, Caldeira et al., (7) found that 9.4% of first-year college students met criteria for a cannabis use disorder (CUD). Given the magnitude of this problem and its seemingly intractable nature, it is unlikely that the U.S. will come even close

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to meeting the Healthy People 2010 goal of reducing binge drinking to 20% of the college population unless new approaches are implemented to reduce substance use and associated problems on college campuses.

Researchers have long advocated for early identification, screening, and intervention with high-risk students as part of a comprehensive approach to reducing problems related to substance use (8–10). Screening instruments that have been suggested for use, such as the CAGE (11), DAST (12), or diary methods to track consumption levels, focus on the assessment of drinking behavior *per se* (13). Very rarely does screening include an assessment of the antecedents known to be associated with the liability to develop addiction. Screening for substance use disorders (SUD) simply on the basis of the behavior itself, without consideration of individual characteristics that are part of the liability to develop the disorder, is akin to screening for skin cancer by dermatologic examinations without inquiring about family history, sun exposure history, or regularity of sunscreen use. While screening for drinking problems *per se* will capture individuals who are currently experiencing problems, it will not necessarily identify individuals who will develop problems sometime in the future.

The question then arises of what items to include on a comprehensive screening instrument. Research over the last forty years has demonstrated that SUD arises from the interaction between individual characteristics (e.g., temperament), environmental circumstances that allow expression of the disorder (e.g., availability), and personal experiences that might exacerbate (e.g., job loss) or reduce (e.g., having a child) the individual's propensity for the development of addiction. More specifically, among college students, investigations have identified a plethora of risk factors for heavy drinking and drug use, from situation-specific variables such as living off-campus (14) and being a member of a fraternity or sorority, to individual-level variables such as perception of social norms, and certain personality characteristics (15) and external peer influences (16). One limitation of this body of work is that most studies have developed explanatory models for heavy alcohol involvement or tobacco use while few have investigated predictors of the development of AUD (17). Even rarer are studies of the interplay between multiple dimensions of liability on the development of SUD among college students.

The investigative team at the Center for Education and Drug Abuse Research (CEDAR) at the University of Pittsburgh (1,18,19) has argued that to truly identify individual SUD risk, one needs to use a multidimensional approach that reflects the underlying etiologic heterogeneity of the disorder. Recently, Kirisci et al., (1) used item response theory (IRT) to develop indices that predicted CUD among a sample of boys studied from the age of 10–12 through early adulthood with 75% accuracy. The resulting Transmissible Liability Index (TLI) consists of a multidimensional selection of items that represent aspects of SUD risk that are shared with an SUD-affected parent, encompassing both genetic and environmental factors. The present study aimed to cross-validate the prior methodology of Kirisci et al., (1) by deriving a set of analogous items that would be potentially useful for characterizing SUD risk across multiple dimensions among college students. The objectives were to: 1) examine whether the TLI-college version (TLI-CV) varied among first-year college students by race, sex, SES, religiosity, and family history of substance use problems; 2) estimate the degree to which the TLI-CV was associated with alcohol and/or marijuana dependence, both cross-sectionally and prospectively, by race and sex; and, 3) examine the sensitivity and specificity of the TLI-CV for identifying cases of marijuana and alcohol dependence.

METHODS

Design

Data were derived from the College Life Study (CLS), an ongoing longitudinal study of college students at a single large, public university in the mid-Atlantic region of the U.S. (20). The sample was recruited in two stages. First, all incoming first-year, first-time college students, ages 17 to 19, were invited to participate in a short web-based screening survey at new-student orientation during the summer prior to college entry in 2004. The first stage response rate was 89%, with 3,401 students completing the screener. Next, a stratified random sample of screener participants for longitudinal follow-up was selected. Students who had used illicit drugs at least once in high school were deliberately oversampled, to ensure adequate power for analyses on drug users.

The response rate at the second stage of sampling was 86%, yielding a cohort of 1,253 individuals for whom a two-hour baseline assessment, consisting of an in-person interview and several questionnaires, was administered sometime during the first year of college. Annual assessments, similar to the first, were administered regardless of continued college attendance. Response rates in years two through four were 91%, 88%, and 88%, respectively, and 81% completed all four interviews ($n=1,018$). Participants received \$5 for screener completion, \$50 for each annual interview, and in years two through four, a \$20 bonus was provided for on-time completion. The study was approved by the university's IRB and a federal Certificate of Confidentiality was obtained.

Participants were representative of the population of first-year students with respect to gender, race and socioeconomic status. Approximately 48% were male, 71% were White, and 74% had a mother who attained a college or graduate degree (20).

Independent Variables

Demographics—Age and gender were recorded at baseline. Mother's educational level was used as a proxy for socioeconomic status. Data on race and ethnicity were collected via self-report at the third annual assessment; multiple responses and write-in data were permitted, and in the 19% that had missing data, race information was gathered from university administrative datasets. Four race categories were constructed: 1) White; 2) Black/African-American; 3) Asian and, 3) Other racial/ethnic groups. Ethnicity was not taken into account in coding race; however, 37% of the "Other" group identified as Hispanic, Latino, or Spanish, whereas only 1% of Whites and 4% of Blacks were Hispanic.

Religiosity was assessed from the following questionnaire item: "How important is religion in your life?" Response options were not important, slightly important, moderately important, and extremely important.

Family history of substance use problems—This was assessed via the family tree questionnaire (21), which yielded the following four possible responses for paternal and maternal alcohol and/or drug problem, separately: "definite," "possible," "no problem," and "not sure/don't remember." A single three-level variable representing the most severe response for either parent was constructed. Responses of "not sure" were treated as missing data; however, cases with missing data on one parent were still retained if a possible or definite problem was indicated for the other parent.

Transmissible Liability Index-College Version (TLI-CV)—Because this study was designed as a replication of prior work on the TLI, the index used in this analysis was not created de novo; rather, it was developed in collaboration with University of Pittsburgh

investigators, who were the original developers of the TLI from their high-risk study of children of fathers meeting SUD criteria consequent to illicit drug use. After discussion about how the CLS had measured constructs that were very similar to the constructs measured in the CEDAR study, a large dataset of 81 individual items from the CLS was provided for IRT analyses. Many of the items were derived from the same instruments and were therefore identical to items in the original TLI; others were judged to represent an adequate proxy based on face validity. In this way, a college-student specific TLI was constructed using IRT, following the same methods described by Kirisci et al., (1). Table 1 lists the 33 items included in the final TLI-CV used in the present analyses.

Dependent Variables

Annually, participants were asked questions adapted from the NSDUH (22) that corresponded to the DSM-IV criteria for past-year alcohol and/or marijuana abuse and dependence (23). Three dependent variables were constructed:

Baseline DSM-IV alcohol and/or marijuana dependence—The analytic sample for baseline dependence consisted of 1,212 individuals with complete data on race, sex, and dependence during the first annual assessment. Individuals not meeting criteria or who used the substance less than five times in the past year were coded as not dependent.

Incident dependence—For the analyses on incident dependence, the analytic sample consisted of the 760 individuals who were not dependent on either alcohol or marijuana at baseline and provided sufficient data to ascertain the presence or absence of dependence in years two through four. Participants who met dependence criteria in at least one of the three annual follow-up assessments were coded as positive for incident dependence. Participants who were non-dependent at every assessment were coded as negative for incident dependence.

Remitting vs. persistent dependence—The available sample was 197 individuals who were dependent on alcohol and/or marijuana at baseline and provided sufficient data on dependence at follow-up. Remitted dependence was defined as meeting criteria for dependence at baseline but then not meeting criteria in years two through four. Persistent dependence was defined as meeting criteria for dependence at baseline and again in at least one follow-up assessment (regardless of whether or not all three follow-ups were completed). Thus, due to differences in inclusion criteria regarding missing data, the reader is cautioned against misinterpreting the resulting counts as incidence rates.

Statistical Analyses

Comparisons of mean TLI-CV scores were performed using *t* tests with Bonferroni corrections for multiple comparisons. To evaluate the possible utility of the TLI-CV as a screener for college students at risk for dependence, ROC (receiver operating characteristic) analyses were conducted. Sensitivity and specificity of the TLI-CV were evaluated at a variety of cutpoints for predicting both alcohol and marijuana dependence, and separately among males and females, regardless of baseline dependence. Sample sizes were not sufficient to examine sensitivity and specificity by race.

RESULTS

Description and Correlates of the TLI-CV

The TLI-CV was normally distributed around a mean of 0 and ranged from −3.93 to 3.50. Table 2 compares the TLI-CV by sex, race, mother's education, family history, and religiosity. Males had significantly higher TLI-CV scores than females, and Asians had significantly higher TLI-CV scores than Blacks/African-Americans. The TLI-CV was not significantly

associated with either mother's education or religiosity. The mean TLI-CV tended to be higher for individuals with a "definite" parental substance use problem relative to those with no parental substance use problems, and this difference was statistically significant for females (0.13 vs. -0.26; $p<.01$) but not for males (0.45 vs. 0.23; $p=.25$). Importantly, the TLI-CV score was highest for males with a definite parental substance use problem and lowest among females without any parental problems. (Participants who provided sufficient data at follow-up for the prospective analyses were slightly but significantly more likely to be female and to have a higher TLI-CV score; data not shown in a table).

The TLI-CV and Baseline Dependence

TLI-CV scores were significantly higher among both alcohol-dependent and marijuana-dependent individuals at baseline; this association was observed for both White males and White females. Within the "Other" race group, TLI-CV scores were significantly elevated for marijuana-dependent individuals but not alcohol-dependent individuals (Table 3). Significance testing was not possible within all race-sex subsets due to empty or extremely small cell sizes.

Prospective Associations between the TLI-CV and Subsequent Dependence

The TLI-CV score was significantly associated with incident alcohol or marijuana dependence among Whites, but only incident marijuana dependence among non-Whites (Table 4). No statistically significant differences on the TLI-CV were observed in the overall sample with respect to "remitting" ($n=42$; 24 females and 18 males) or "persistent" dependence ($n=155$; 72 females, 83 males). Small sample sizes precluded definitive interpretation of race-sex group differences (data not shown in a table).

Sensitivity and Specificity of the TLI-CV

Table 5 shows that the TLI-CV provides only a modest improvement over chance in predicting dependence, based on the area under the curve (ranging from 0.62 to 0.67). The tradeoffs between sensitivity and specificity were apparent for both males and females, but certain differential results are noteworthy. When specificity was optimized at around .90, the TLI-CV detected a greater proportion of the marijuana and alcohol dependence cases among males (0.21, 0.29) than females (0.11, 0.18). When the cutpoint was lowered to optimize sensitivity, the resulting sacrifice in specificity was greatest for marijuana dependence in males (0.13). Regardless of whether sensitivity or specificity was optimized in selecting the cutpoint for a positive screen, positive predictive value (PPV) remained modest or low (ranging from 0.11 to 0.56), while negative predictive value (NPV) was high (all >0.70). Not surprisingly, the more extreme threshold, set at two standard deviations above the mean, yielded very high specificity in each analysis (all at 0.99), but detected very few of the true dependence cases (3% or less).

DISCUSSION

This study demonstrates the heuristic value of the TLI-CV for identifying college students who may be at high risk for dependence on alcohol or marijuana. In our cohort of first-year college students, the TLI-CV was significantly associated with dependence at baseline, yet it was also significantly higher for non-dependent individuals who later became dependent during the subsequent three years of college. It is noteworthy that the TLI-CV demonstrates usefulness in a college student population, who by virtue of being admitted to college can be assumed to have acquired some successful strategies for overcoming their childhood vulnerabilities. An important contribution of this study is that these associations were observed in a variety of demographic groups, including females, Blacks/African-Americans, Asians, and other racial minorities, in addition to replicating prior work demonstrating the utility of the TLI among White males (1). As expected, the TLI-CV was associated with having a family history of

alcohol or drug problems, but this association reached statistical significance only among females. This finding is in contrast to the work of others who observed significant associations with family history in males, but not females. It is possible that this inconsistency could be due to differences in the methodology for measuring family history (e.g., including both maternal and paternal family history) and the accuracy of reporting between male and female college students.

Several limitations of the study must be acknowledged. First, small sample sizes within certain racial minority groups precluded the detection of significant differences, especially when examining race-sex subgroups. Second, the findings are probably not generalizable to college student populations with different characteristics (e.g., small, private colleges).

Although the TLI-CV was significantly predictive of both baseline and incident dependence in this sample, its sensitivity and specificity are far from optimal. More research is needed to understand the possible reasons for this discrepancy. From analyses of national samples, it appears that the peak age of risk for CUD is 18–19 years old (24). For college-bound students, the age of onset might be slightly higher because of differences in environmental contexts. Therefore, increasing sensitivity and specificity for a screening instrument for SUD in college students might have to take into account not only items on the TLI-CV but environmental factors. Also, considering that the TLI was originally developed as a correlate of paternal illicit drug problems, it may not be equally effective in detecting alcohol addiction propensity. Moreover, it is possible that improvements in sensitivity and specificity could be observed if the TLI-CV was used in conjunction with an assessment of substance use behavior, such as those typically used in prevention programs (e.g., CAGE, DAST). Because the TLI was developed to measure a certain type of risk for SUD, rather than the overall magnitude of risk, it is not surprising that its PPV was relatively small in this study. However, the high NPV suggest that the TLI-CV might be useful primarily in ruling out the relatively severe heritable-risk phenotype described by Tarter, Vanyukov, and colleagues (18,19). Future studies with this cohort will aim to examine the utility of the TLI-CV using a multi-stage screening approach, which may be more sensitive to a broader range of etiologic pathways to developing a SUD among young adult males and females who attend college.

The choice of a threshold for a “positive” screen on the TLI-CV is largely subjective and dependent on situation-specific factors. In the case of colleges and universities, salient factors include the availability of resources for prevention and evaluation and the level of institutional commitment to ameliorating students’ substance use problems. For instance, in a setting where prevention funds are scarce and early identification is not an institutional priority, a higher TLI-CV threshold would be warranted, sacrificing sensitivity in order to capture the most serious cases. In a more ideal environment, a lower TLI-CV threshold would be useful in identifying a broader range of students who might then receive a broad-based informational intervention or a more thorough risk assessment, with only the highest-risk minority then being referred for more intensive personalized intervention.

Many colleges have yet to systematically adopt policies that identify at-risk students and intervene effectively. All too often, the practice at most institutions is to intervene at the point of a crisis (25–27). Students are identified when a drinking or drug-related consequence occurs, such as an arrest, failing a class, or in the most tragic cases, a death related to alcohol poisoning or a drug overdose. Yet college represents a unique and valuable opportunity for early screening and intervention. If correctly implemented, early screening and intervention strategies could capitalize on college students’ motivation to perform well academically. To be most effective, screening strategies therefore must take into account the complexity of the etiology of SUD, as well as account for developmental changes native to the college years. The present study points to possibilities for improving current approaches that are limited to assessing drinking

and drug use behavior *per se* to identify at-risk students. While significant work remains to be done to refine the methodology, this approach holds much promise to modify the trajectories of students who may be at risk for the development of SUD.

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TABLE 1
College Life Study items used for an adaptation of the Transmissible Liability Index.

Source: Dysregulation Inventory (¹)	Response Options
1. I can't sit still for long.	0 = Never True
2. I begin to answer a person's questions before the person is finished.	1 = Occasionally True
3. I stick to a task until it is finished.	2 = Mostly True
4. I hit someone when I really get mad.	3 = Always True
5. I interrupt people when they are speaking.	
6. I lose sleep because I worry.	
7. I get into trouble because I can't think before I act.	
8. I have difficulty keeping my attention on tasks.	
9. I get into fights.	
10. I consider what will happen before I make a plan.	
11. I spend money without thinking about it first.	
12. I jump into situations before I think them through.	
13. I get impatient waiting my turn in games or sports.	
14. I make threats to people I know.	
Source: Beck Depression Inventory (BDI) (²)	Response Options
15. Getting tired	0 = I don't get tired more than usual. 1 = I get tired more easily than I used to. 2 = I get tired from doing almost anything. 3 = I am too tired to do anything.
16. Worrying about physical problems	0 = I am no more worried about my health than usual. 1 = I am worried about physical problems such as aches or pains, or upset stomach, or constipation. 2 = I am very worried about physical problems and it's hard to think of much else. 3 = I am so worried about my physical problems that I cannot think about anything else.
Source: Conduct Disorder Screener (³)	Response Options
Before you turned 18, how many times did you...	0 = Never
17. Break rules?	1 = Once
18. Damage property on purpose?	2 = Twice

Source: Dysregulation Inventory (1)	Response Options
19. Start fights with people?	3 = Three times
20. Run away from home (overnight) at least twice while living at home or once without returning for a lengthy period?	4 = More than three times
21. Steal something from someone?	
22. Lie to get something or to avoid responsibility?	
23. Take property belonging to others?	
24. Used a weapon in a fight?	
25. Hurt others physically?	
Source: Center for Epidemiologic Studies Depression Scale (CES-D) (4)	Response Options
26. During the past week, I enjoyed life.	1 = Rarely or none of the time (less than 1 day) 2 = Some or a little of the time (1–2 days) 3 = Occasionally or a moderate amount of time (3–4 days) 4 = Most or all of the time (5–7 days)
Source: Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) (5)	Response Options
27. I am an impulsive person.	1 = True
28. I have a very strong temper.	0 = False
29. I often do things on impulse.	
Source: NEO-FFI (6)	Response Options
30. I'm hard-headed and tough-minded in my attitudes.	1 = Strongly disagree
31. I often get angry at the way people treat me.	2 = Disagree
32. I believe that most people will take advantage of you if you let them.	3 = Neutral
	4 = Agree
	5 = Strongly Agree
Source: College Life Study Baseline Interview (7)	Response Options
How many times did the following things happen to you during high school?	0 = Never

Source: Dysregulation Inventory (¹)	Response Options
33. You were put on probation from school.	1 = 1-2 times 2 = 3-6 times 3 = 7-9 times 4 = 10 times or more

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TABLE 2

Comparisons of mean TLI-CV scores by demographics, religiosity, and family history of substance use problems.

	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>Sig.</i>
Sex				
Female	645	−0.21	0.94	***
Male	608	0.23	1.01	
Race				
White	915	−0.02	0.96	
Black/African-American	116	−0.19	1.05	** ^a
Asian	113	0.22	1.13	
Other/Multiple	108	0.16	1.07	
Mother's Education				
Less than high school	15	0.15	1.10	
High school or GED	175	0.05	1.04	
Some college or technical	116	0.03	0.93	
Bachelor's degree	439	−0.02	1.02	
Graduate degree	413	−0.04	1.03	
Importance of Religion				
Not important	323	0.03	0.91	
Slightly important	300	0.04	1.01	
Moderately important	385	−0.02	1.02	
Extremely important	238	−0.06	1.07	
Males: Family History of Substance Use Problems				
No problems	289	0.23	0.99	
Possible problems	69	0.12	1.02	
Definite problems	40	0.45	0.88	
Females: Family History of Substance Use Problems				
No problems	290	−0.26	0.92	
Possible problems	98	−0.07	0.98	
Definite problems	59	0.13	0.91	** ^b

*
 $p < .05$ **
 $p < .01$ ***
 $p < .0001$ ^a Blacks had a significantly lower mean TLI-CV than Asians.^b Among females, individuals with definite parental problems had a significantly higher mean TLI-CV than individuals with no parental problems.

Note: Comparisons were performed using all available data for each variable. Categories do not always sum to 1,253 due to missing data.

TABLE 3

Comparison of mean TLI-CV scores for students who were and were not dependent on alcohol (ALC) or marijuana (MJ) in the first year of college, by sex and race.

Dependent on neither ALC nor MJ (ALC- MJ-)										Dependent on ALC but not MJ (ALC+ MJ-)			Dependent on MJ (MJ+)			Sig.
n										n			n			SD
Mean										Mean			Mean			SD
SD										SD			SD			
Females, by Race																
White	355	-0.34	0.91	67	0.12	0.80	23	0.16	0.74	1						
Black	68	-0.26	1.04	4	0.14	0.44	0	.	.							
Asian	48	-0.25	1.14	4	0.31	0.74	1	0.50	.							
Other/Multiple	48	0.00	0.94	8	0.27	0.70	2	0.49	0.61							
All Females	519	-0.29	0.96	83	0.14	0.77	26	0.20	0.71	1						
Males, by Race																
White	347	0.07	0.94	52	0.83	0.81	41	0.59	0.85	1						
Black	40	-0.11	1.09	3	0.20	1.54	0	.	.							
Asian	46	0.54	1.02	8	0.51	1.23	3	1.52	0.65							
Other/Multiple	32	0.02	1.28	7	0.95	0.57	5	1.42	1.21	2						
All Males	465	0.09	1.00	70	0.78	0.87	49	0.73	0.92	1						
Females and Males, by Race																
White	702	-0.14	0.95	119	0.43	0.88	64	0.44	0.83	1						
Black	108	-0.21	1.06	7	0.16	0.94	0	.	.							
Asian	94	0.13	1.15	12	0.44	1.06	4	1.26	0.73							
Other/Multiple	80	0.01	1.08	15	0.59	0.71	7	1.15	1.12	2						
All	984	-0.11	0.99	153	0.44	0.88	75	0.55	0.88	1						

Note: The MJ+ category was defined without regard for ALC dependence; 27 individuals were dependent on both ALC and MJ.

¹ Both the MJ+ group and the ALC+MJ- group are significantly different from the ALC-MJ- group ($p < .05$), but are not significantly different from each other.

² The MJ+ group is significantly different from the ALC-MJ- group ($p < .05$).

TABLE 4

Comparison of mean TLI-CV scores for students who did and did not become incident alcohol (ALC) or marijuana (MJ) dependence cases during years two through four of college, among 760 individuals who were not dependent on either substance in year one.

	No incident Dependence (ALC- MJ-)			Incident ALC dependence but no incident MJ dependence (ALC+ MJ-)			Incident MJ Dependence (MJ+)			Sig.
	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>	
Females, by Race										
White	216	-0.51	0.89	50	0.02	0.82	19	0.08	0.89	<i>1</i>
Black	47	-0.48	1.04	5	0.49	0.85	2	0.39	0.55	
Asian	33	-0.38	1.17	7	-0.28	1.21	0	.	.	
Other/Multiple	29	-0.22	0.92	1	0.51	.	5	0.17	0.55	
All Females	325	-0.47	0.94	63	0.03	0.87	26	0.12	0.80	<i>1</i>
Males, by Race										
White	186	-0.07	0.93	42	0.40	0.88	35	0.34	0.95	<i>1</i>
Black	21	-0.26	0.96	2	0.14	1.47	7	0.50	0.90	
Asian	22	0.26	0.92	5	0.40	1.13	5	1.25	0.70	
Other/Multiple	14	0.21	1.26	6	0.24	0.55	1	0.71	.	
All Males	243	-0.04	0.95	55	0.38	0.87	48	0.46	0.93	<i>1</i>
Females and Males, by Race										
White	402	-0.31	0.93	92	0.19	0.87	54	0.25	0.93	<i>1</i>
Black	68	-0.41	1.01	7	0.39	0.93	9	0.47	0.80	2
Asian	55	-0.13	1.11	12	0.01	1.17	5	1.25	0.70	2
Other/Multiple	43	-0.08	1.05	7	0.28	0.51	6	0.26	0.54	
All	568	-0.29	0.97	118	0.19	0.88	74	0.34	0.90	<i>1</i>

¹ Both the MJ+ group and the ALC+MJ- group are significantly different from the ALC-MJ- group ($p<.05$), but are not significantly different from each other.

² The MJ+ group is significantly different from the ALC-MJ- group ($p<.05$).

Results of ROC analysis of TLI-CV for predicting marijuana and alcohol dependence in years two through four of college, by gender. Sensitivity and specificity were analyzed using three different methods to select a cutpoint.

TABLE 5

	Males			Females	
	Marijuana Dependence (n=476)	Alcohol Dependence (n=469)	Marijuana Dependence (n=549)	Alcohol Dependence (n=541)	
Area under the curve	.62	.67	.63	.64	
Cutpoint Selection Method 1: Optimize Specificity					
TLI-CV cutpoint for positive screen	1.30	1.10	.90	.80	
Sensitivity	.21	.29	.11	.18	
Specificity	.89	.89	.90	.90	
Positive Predictive Value	.35	.56	.11	.42	
Negative Predictive Value	.81	.72	.90	.73	
Cutpoint Selection Method 2: Optimize Sensitivity					
TLI-CV cutpoint for positive screen	-1.00	-.40	-1.00	-1.00	
Sensitivity	.91	.90	.91	.90	
Specificity	.13	.32	.21	.23	
Positive Predictive Value	.22	.39	.12	.32	
Negative Predictive Value	.84	.87	.95	.85	
Cutpoint Selection Method 3: Mean + 2 SD					
TLI-CV cutpoint for positive screen	2.30	2.30	1.70	1.60	
Sensitivity	.03	.03	.02	.01	
Specificity	.99	.99	.99	.99	
Positive Predictive Value	.43	.57	.25	.20	
Negative Predictive Value	.79	.68	.90	.71	