

Predicting Juvenile Recidivism: Accuracy and Validity of the Adolescent Chemical Dependency
Inventory-Corrections Version II (ACDI-Corrections Version II)

Abstract

Risk assessment has been widely applied in corrections settings; however the appropriateness and psychometric properties are often overlooked in decision making. Findings indicate that the ACDCI-Corrections Version II juvenile assessment is a valid test that distinguishes between low risk and severe risk juvenile offenders. Moreover, the inclusion of dynamic factors (violence propensity, adjustment to incarceration, and stress management) enhanced the predictive capabilities of recidivism as measured by negative binomial regression. ROC/AUC analyses were conducted to examine accuracy of risk classification in predicting recidivism. These findings add to the existing literature on juvenile offender rates of reoffending and clinical implications are provided.

Keywords: juvenile delinquency, risk assessment, ROC/AUC, validity, accuracy

Predicting Juvenile Recidivism: Accuracy and Validity of the Adolescent Chemical Dependency Inventory-Corrections Version II (ACDI-Corrections Version II)

In recent years researchers have explored risk factors associated with juvenile offending and recidivism. Factors include personal characteristics, prior criminal history, institutional conduct, substance abuse, family characteristics, and social and environmental characteristics. Work in this area has developed a composite of offenders and those who are likely to reoffend. The profile of offenders is composed of static (gender, criminal history, antisocial traits) and dynamic factors which are amenable to change through treatment or intervention (substance abuse, education) (Andrews & Bonta, 2010). Identifying salient risk factors can guide classification and rehabilitation decision making.

Longitudinal research suggests that most juveniles do not reoffend (Piquero, Brame, & Moffit, 2005) but a percentage of offenders will. With accurate identification of risk potential and factors associated with recidivism, appropriate interventions and treatments can be matched to meet the needs of an inmate. This is often referred to as the risk principle (Andrews & Bonta, 2010). The risk principle recommends that higher risk probationers receive higher intensity interventions; whereas, lower risk probationers receive lower intensity interventions. Risk principle represents the foundation upon which the ACDI-Corrections Version II was established. Previous research has demonstrated that treatment matched to juvenile offender risk is more effective than treatment that is not (Luong and Wormith, 2011; Mackenzie & Brame, 2001; Vincent, Guy, Gershenson, & McCabe, 2012).

The purpose of this study was to examine the validity of ACDI-Corrections Version II, as a juvenile screening instrument while simultaneously replicating earlier work on juvenile risk prediction (Lattimore et al., 2004; Trulson et al., 2011). It was expected that the ACDI-

Corrections Version II would differentiate between offenders who demonstrate low and severe risk. Moreover, it was hypothesized that assessment scores measuring dynamic factors would enhance prediction of juvenile offender rates of re-incarceration over static factors including personal characteristics and self-reported criminal history.

Methodology

Participants

There were 14,415 juvenile delinquents who completed the ACDI-Corrections Version II from December 2001 through June 2013. Data were submitted by corrections, probation, and treatment staff across the United States who implemented the ACDI-Corrections Version II as part of their juvenile screening or clinical intake procedures. Seventy-five percent of the offenders were male and 25% were female. The average age of offenders was 15. The majority of offenders, 57%, were African Americans, 34% were Caucasian, 5% were Hispanic, less than 1% were Asian and Native American, and approximately 2% of offenders selected Other; however no additional race or ethnicity information was provided. Approximately 9% of offenders graduated 6th grade, 13% completed 7th grade, 22% completed 8th grade, 23% completed 9th grade, 11% completed 10th grade, 1% completed 11th grade, and less than 1% had completed some college.

Instruments

The ACDI-Corrections Version II is a self-report assessment developed to help meet the needs of juvenile corrections departments by assessing juvenile offenders' alcohol and drug abuse, adjustment, coping skills, and lethality. The ACDI-Corrections Version II is comprehensive using a combination of static and dynamic factors that address seven areas associated with juvenile offender risk. The ACDI-Corrections Version II consists of 140 items

using true/false and multiple choice formats. The seven scales include: Truthfulness Scale, Alcohol Scale, Drug Scale, Adjustment Scale, Violence Scale, Distress Scale, and Stress Coping Abilities Scale. The ACDI-Corrections Version II requires approximately 35 minutes for completion and written at the 5th grade reading level. The ACDI-Corrections Version II can be administered individually or in groups and audio administration is available for offenders with learning disabilities. The ACDI-Corrections Version II training manual recommends that test results be used in conjunction with a review of available records and experienced staff judgment. Each of the ACDI-Corrections Version II scales is briefly described below; additional information can be found at www.acdi-corrections-versionII.com.

Truthfulness Scale. The Truthfulness Scale consists of 21 true/false items that measure how truthful the juvenile offender was while completing the test. It identifies guarded and defensive juvenile offenders who attempt to minimize problems or attempt to “fake good”. All interview and self-report information is subject to the dangers of untrue answers due to defensiveness, guardedness, or deliberate falsification. This is of particular concern in corrections where juvenile offenders often attempt to minimize their problems and/or concerns in an effort to obtain more favorable classification and disposition (Benedict, & Lanyon, 1992; Piquero, Farrington, & Blumstein, 2003; Roberts & Wells, 2010).

Alcohol and Drug Scales. The Alcohol and Drug Scales measure juvenile offenders’ admissions of alcohol or drug abuse problems, participation in previous substance abuse treatment, as well as plans for substance abuse treatment upon release from prison. Both scales consist of 18 items and use true/false and multiple choice formats. Substance abuse and dependency are prevalent among the juvenile offender populations (Lattimore et al., 2004). Substance abuse is recognized as a dynamic factor that is associated with recidivism risk and

underscores the need for early identification when addressing prison based treatment alternatives and post-incarceration rehabilitation.

Violence Scale. This scale measures the expression of anger and hostility through physical force. The Violence Scale consists of 21 true/false and multiple-choice items that assess the expression of physical force against another person. Early assessment, using measures of violence propensity, can provide information crucial to the development of interventions and management techniques to reduce violence during incarceration, as well as reduce the potential for violence after release.

Adjustment Scale. The environmental and emotional factors an offender must deal with include overcrowding, isolation for safety, victimization, as well as pre-incarceration factors, all of which can impact a prisoner's ability to successfully adjust to incarceration and life after release (Dhami, Ayton, & Loewenstein, 2007; Haney, 2002). This scale uses 25 true/false items and multiple choice items.

Distress Scale. The distress scale measures juvenile offenders discomfort, unhappiness, and pain, including indicators of internalizing anxiety, shame, and depression, as well as externalization of these emotions through physical problems including insomnia, fatigue, and restlessness. The Distress Scale contains 25 items and uses a true/false format that measures two symptom clusters, anxiety and depression. Merging of these symptom clusters is clear in the definition of dysphoria (American Psychiatric Association [APA], 2000). It is important to measure the degree of severity of perceived distress because of its broad applicability to juvenile offenders' adjustment, intervention, and outcome.

Stress Coping Abilities. This scale consists of 29 items and uses a 4-point rating scale that assesses juvenile offender ability to effectively cope with tension, stress, and pressure.

Exposure to stressors has been extensively studied as a cause of criminal behavior (Agnew, 1992; Eitle & Turner, 2003) with increased exposure to stress being linked to more violent forms of delinquency (Aseltine, Gore, & Gordon, 2000). The effect of stress exposure can be moderated by the ability to effectively cope (Agnew; Aseltine, Gore, & Gordon). The Stress Coping Abilities Scale identifies juvenile offenders who are not coping effectively with stress.

Risk Ranges. For each ACIDI-Corrections Version II scale respondents are classified into four risk ranges: Low Risk (zero to 39th percentile), Medium Risk (40th to 69th percentile), Problem Risk (70th to 89th percentile), and Severe Problem (90th to 100th percentile). Risk ranges represent degree of severity, and were established by converting raw scores to percentile scores using cumulative percentage distributions (Behavior Data Systems, 2012). Early instrument development included the use of content experts to confirm the proposed risk ranges. Data analyses, in combination with field reports from experienced evaluators have confirmed that these percentile categories provide accurate identification of problem behavior (Behavior Data Systems).

In addition to establishing risk thresholds, the risk ranges serve an important role when interpreting Truthfulness Scale scores. A truthfulness concern is identified when a Truthfulness Scale score is at or above the Problem Risk range (70th percentile). These respondents are typically cautious, guarded or may be defensive in their answers. Scores in the Problem Risk range should be interpreted cautiously. Severe problem scores on the Truthfulness Scale (90th percentile and above) invalidate all other scale scores. Invalid scores were removed from the sample (n= 2,506) for later analyses.

When completing the ACIDI-Corrections Version II, juvenile offenders provided information about their criminal and incarceration history. These variables included arrests,

hearings, detentions, probation sentences, probation revocations, alcohol-related arrests, and drug-related arrests. The items were open-ended which allowed juvenile offenders to enter a number; responses ranged from 0- 35.

Procedures

Construct validity was established through use of contrast groups. This approach differentiates between juvenile offenders who are known to have higher risk factors and those known to have lower risk factors by comparing mean scale scores (DeVon, et al., 2007). In this analysis, juvenile offenders with one arrest were categorized as first-time offenders and juvenile offenders with two or more arrests were categorized as repeat offenders. It was anticipated that repeat offenders' mean scale scores would be higher than first-time juvenile offenders' mean scale scores indicating more severe problems and risk. Fifty-nine percent were first-time offenders and 41% were repeat offenders.

Regression was used for the recidivism prediction; regression allows researchers to examine individual risk factors and all factors simultaneously. Number of probation revocations served as the outcome variable for this analysis. Revocations occur when probationers violate a condition or requirement of their supervision and are incarcerated. Moreover, recidivism is considered an indicator of "return on correctional investment (p. 6)" (PEW, April 2011).

Negative binomial regression was selected for use in this study because probation revocations are constrained to zero and are non-normally distributed; this violates assumptions of linear regression and requires use of a specialized statistic. In addition, negative binomial regression does not assume independence of future events like arrests and revocations (Trulson, et al., 2011). Three separate binomial regression models were developed, one for each set of predictor factors to determine if the scale scores predicted recidivism beyond what is accounted for by demographic and criminal history characteristics (static factors).

Three sets of predictor variables included: demographic characteristics, self-reported criminal history, and ACIDI-Corrections Version II scale scores. Demographic variables included age, gender and race/ethnicity. Race/ethnicity was dummy coded for inclusion in the model. Age was selected as an offset variable to account for the increased time that an older juvenile may have had to accumulate a criminal history. Criminal history items included number of prior arrests, alcohol-related arrests, and drug-related arrests. To ensure validity of the criminal history sample, outlier scores, values identified above the 99th percentile, were removed (n = 763). Scale scores made up the final set of predictor variables. The scales were divided by 10 to facilitate interpretation; thus, regression coefficients correspond to a 10% change in the given scale rather than a 1% change. Table 1 provides a summary of the predictor variables included in each analysis.

A correlation analysis and linear regression were conducted to ensure appropriateness of the model. As noted in Table 2, probation revocations were positively related to the criminal history items; coefficients ranged from .02 -.42, very small to medium effect sizes respectively. The relationships between probation revocations and scale scores were also statistically significant, showing weak to moderate relations with the scale scores (.13 – .24). Although highly correlated, regression still permits the examination of the individual variance for each predictor on probation revocations.

A second analysis was conducted to examine the multicollinearity of the predictor variables. As Fields (2010) noted, if predictor variables are highly correlated it is very challenging to examine the “unique estimates of the coefficients....values become interchangeable” (p.223) leading to a biased regression model. No multicollinearity concerns

were identified in this process; thereby, permitting further regression analyses using the negative binomial approach.

Accuracy was assessed using ROC/AUC analyses (receiver operating characteristics/area under the curve analysis). ROC analysis was selected because it simultaneously measures specificity and sensitivity of the assessment, and is not influenced by low base rates (like reoffending). The AUC statistic conveys the probability that a randomly selected repeat offender would have a more deviant score than a randomly selected offender who has not reoffended (Craig & Beech, 2009). To facilitate this analysis a binary variable was created using probation revocations, $0 = \text{non- recidivist}$; $1 = \text{recidivist}$.

Analysis

T-test analyses were used to examine offender group differences. Corrections were made for differences in variance and the Bonferonni adjustment was applied to control for experimentwise alpha inflation.

Three negative binomial regression analyses were conducted to ensure that the addition of scale scores contributed to the overall fit of the model and prediction capabilities. The first analysis was the baseline model which included no predictor variables, the second analysis included the demographic variables and criminal history variables. The final analysis included all static factors used in the prior analysis and added ACIDI-Corrections Version II scale scores on the Alcohol Scale, Drug Scale, Violence Scale, Distress Scale, Adjustment Scale, and Stress Coping Abilities Scale. Due to the large number of variables included in the regression, the significance of the individual parameter estimates was based on a Bonferroni adjusted p -value of .004.

ROC/AUC analyses used risk classifications for each of the ACIDI-Corrections Version II scales, along with the new binary variable. Any finding with an AUC above .50 had predictive validity better than chance (50/50). Interpretation of AUC results varies depending on the needs of the test user but generally accepted standards indicate 1.0 -.90 = excellent, .90 -.80 = good, .80 -.70 = fair, .70 -.60 = poor, and .60 -.50 = very poor.

Results

A comparison between the mean scores, using percentiles, of the first-time offenders and repeat offenders was conducted. For example, a score of 48.12 on the Violence scale suggests that a person with this score was near the 48th percentile compared to other juveniles in the study. Table 3 summarizes the results. Repeat offenders had higher scale scores than first time offenders; *t*-test results were statistically significant. Effect sizes using Cohen's *d* were calculated and ranged from about .02 -.7, representing small to large effects respectively. In the prediction study, the baseline model that included just the intercept was conducted which did not fit the data well, $\chi^2(13140) = 30396.12, p < .001$. Next, a model estimating the predictive effects of the demographic and criminal history factors was applied. This model fit the data better, and represented a significant increase in fit beyond the baseline model, $\chi^2_{diff}(7) = 3712.93, p < .001$. Adding demographics and criminal history variables improved the prediction model.

Finally, a third negative binomial regression was estimated to test the hypothesis that the addition of scale scores, representing dynamic factors, predicted probation revocations beyond the demographic and static factors examined. The model including the dynamic factors fit the data well, $\chi^2(11883) = 4202.52, p < .001$, and resulted in a significant improvement in fit beyond the model including only the demographic and static factors, $\chi^2_{diff}(6) = 69.94, p < .001$.

These results indicated that, beyond demographic and static variables, scale scores, representing factors amenable to change, are important for the prediction of probation revocations.

The results of the final model are presented in Table 4 and displayed regression coefficients (*b*), the factor change in the expected revocation rate, and the percentage of change in expected revocations for a one unit change in the predictor variables. After controlling for demographic and criminal history characteristics, the number of probation revocations was significantly related to four of the six scales after applying Bonferroni correction.

The results indicated that race, as well as number of detentions, and levels of violence, adjustment, and stress management had a positive and statistically significant effect on probation revocations. With regard to race, African American offenders were 3% less likely to have a probation revocation than Caucasian juvenile offenders. It was estimated juvenile offenders in the Other racial/ethnicity category were 225% more likely than Caucasian offenders to have probation revocations. Those with more detentions had a 53% increase in expected rates of probation revocations. Moreover, probation revocations rose 14% for every 10% increase in violence propensity and violent behaviors. The largest predictor of probation revocations was adjustment to incarceration; juvenile offenders who reported adjusting poorly to incarceration had 112% increase in expected probation revocations. Poor stress management and coping abilities were associated with a 4% increase in expected probation revocations.

Results of the ROC/AUC analysis identified five of the seven scales above the .50 threshold; results are summarized in Figure 1. Truthfulness Risk (.49) and Stress Risk (.42) predicted revocations no better than chance. Alcohol Risk (.56), Drug Risk, (.66), Violence Risk (.70), Distress Risk (.65), and Adjustment Risk (.70) predicted revocations better than chance.

Craig and Beech (2009) assert that these AUC indices correspond to effect sizes ranging from small to medium respectively (p. 200).

Discussion

Findings in the current study indicate that the ACIDI-Corrections Version II juvenile assessment is a valid test that distinguishes between low risk and severe risk juvenile offenders. Moreover, the inclusion of dynamic factors (violence, adjustment, stress management) in the ACIDI-Corrections Version II enhances the predictive capabilities of recidivism and identifies areas of offender need and treatment targets. These findings add to the existing literature on juvenile offender rates of reoffending.

Previous research has identified several factors associated with juvenile offender risk (DeLisi et al., 2010a; DeLisi et al., 2010b; Lattimore et al, 2004; Piquero et al., 2001; Trulson et al. 2011). Results in this study confirm and diverge from these earlier findings. In our study, male and female juvenile offenders were equally likely to experience probation revocations. African American juvenile offenders were less likely to experience probation revocation compared to other offenders in the sample; offenders categorized and self-identified as Other were more likely than Caucasian and African American offenders to experience probation revocations. Among the criminal history items, number of detentions was the only item that was statistically significant in the model and accounted for a 53% increase in estimated probation revocations. This is consistent with other research that indicated juvenile offenders processed in the justice system were more likely to reoffend than offenders who were diverted from the justice system (Petrosino, Turpin-Petrosino, Guckenburg, 2010). While number of arrests was not statically significant it is important to note that, as a predictor, it was associated with a 50% increase in estimated probation revocations.

Among the six ACDI-Corrections Version II scales, only the Violence Scale, Adjustment Scale, and Stress Coping Abilities Scale were statistically significant in the model and were predictive of probation revocations. High propensity for violence, poor adjustment, and poor coping were predictive of probation revocations. Those juvenile offenders, who demonstrated problem and severe risk on these scales, had increased estimates of probation revocations. Inclusion of these dynamic factors improved predictive capabilities of the ACDI-Corrections Version II which has important clinical implications. Luong and Wormith (2011) found a 38% reduction in juvenile reconvictions when risk classification was appropriately matched, and implemented, to meet treatment needs. Research has also demonstrated that adherence to the risk principles can impact juvenile disposition outcomes, resource allocation, and juvenile recidivism rates (Vincent et al., 2012).

The accuracy results underscore the results of the negative binomial regression, five of the seven scales predicted revocations better than chance, including Violence risk and Adjustment risk. Alcohol and drug risk performed better than chance at predicting probation revocations, but were did not contribute to the overall model. Guardedness, denial, and problem minimization, as measured by the Truthfulness Scale, were not predictive of probation revocations. Contrary to the negative binomial model, stress management, as a predictor of revocations, performed poorer than chance. This finding may be related to interaction of variables in the model, but is worthy of further exploration. Despite poor accuracy results, the information provided by the scales remains relevant with regard to offender decision making, treatment recommendations, and community reintegration planning.

Limitations

Despite the promising psychometric findings of the ACIDI- Corrections Version II there are some limitations related to this study including test administration, psychometric properties, and methodology. As noted earlier, the authors and test designers have limited knowledge, or input into, how the test is administered to offenders by the various corrections department or probation agencies. Inmate data was returned to the authors for analysis and interpretation. Corrections staff were provided general test administration guidelines as outlined in the training manual; however inconsistencies in test administration, security classification, and environment may impact results. Field research using the ACIDI-Corrections Version II should include a description of administration procedures, as well as examine accuracy of risk prediction on recidivism rates. To this end, collaboration with agencies to examine long term test data would expand the existing knowledge of inmate recidivism and treatment planning.

A causal relationship between scale scores, recidivism rates, and treatment outcomes could not be established because the data collected were not longitudinal. Collecting longitudinal data is time and resource intensive; however, it may be worth considering as this type of methodology would provide the necessary data to test whether the ACIDI-Corrections Version II could identify, at an individual level, which offenders had the greatest likelihood of committing offenses while in custody and upon release. While a limitation for this project, the collection of longitudinal data is an area for future research.

Finally, the methodological approach adopted by this study assumes the offender is unchanging and that prior criminal acts reflect a persistent state or criminal propensity. Moreover, this approach assumes that offenders will reoffend when released. While prior criminal history, have demonstrated strong predictive abilities on recidivism (Andrews & Bonta, 2010) research demonstrates that pro-social activities, substance abuse treatment, and strong

positive peer relationships can reduce reoffending rates. This reliance on a static dependent variable introduces bias into the study (Saltzman, Paternoster, Waldo, & Chiricos, 1982) and may lead to an overestimation of the relationship between the variables. For this reason, caution should be used when interpreting the results of this study or other studies which use this type of methodology.

Conclusions

The ACIDI-Corrections Version II was developed to assess inmate risk, as well as identify juvenile offender coping abilities, adjustment, and psychological needs. Moreover, risk assessments like the ACIDI-Corrections Version II have demonstrated significant advantages over risk assessments that rely solely on interviews and clinical impressions (Andrews & Bonta, 2010) and these findings support this assessment as a tool that effectively differentiates between juvenile offenders who represent low and severe risk. In addition, results contribute to identifying areas of offender need and facilitating the development of pro-social skills including self-regulation, problem solving, and anger management strategies. Moreover, aiding juveniles in identifying noncriminal alternatives and noncriminal peers while detained or in custody will reduce the incidents of reoffending (Mackenzie & Brame, 2001). Addressing risk and needs early can facilitate successful community reintegration for the juvenile offender, change trajectory of criminal behaviors, and enhance public safety (PEW Center on the States, April 2011).

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Table 1

Criterion Variables and ACDI Corrections Version II Scales (n = 11, 909)

	Min	Max	Mean	SD
Demographic				
Age	10	23	15.2	1.41
Criminal history				
Probation revocations	0	10	.20	.76
Arrests	0	13	1.90	1.90
Detentions	0	10	1.01	1.47
Alcohol-related arrests	0	3	.12	.37
Drug-related arrests	0	3	.24	.52
Scales				
Alcohol	0	99	21.25	28.86
Drug	0	99	37.41	33.73
Violence	0	99	48.12	27.20
Adjustment	0	99	46.02	25.82
Distress	0	99	54.62	26.89
Stress Coping Abilities	0	99	51.41	23.95

Table 3

Mean Score Comparison and t-Test Results (n = 11, 909)

<u>Scales</u>	<u>First Time Offenders</u>	<u>Repeat Offenders</u>	<i>t</i>	<u>df</u>	<i>p</i>	<u>d</u>
Truthfulness	55.01	54.52	1.05	12402.2	.29	.02
Alcohol	21.95	27.94	-10.54	11549.0	.000	.19
Drug	32.43	49.64	-28.7	12101.7	.000	.50
Violence	42.26	60.32	-37.94	12373.5	.000	.66
Adjustment	52.69	59.34	-14.46	12869.3	.000	.25
Distress	43.67	52.32	-17.79	12645.4	.000	.31
Stress Coping Abilities	50.56	55.53	-11.31	12611.6	.000	.20

Table 4

Negative Binomial Regression Model of Probation Revocations (n = 11, 909)

	<i>b</i>	Exp (<i>b</i>)	% Exp(<i>b</i>)
Male (reference category)			
Female	-.08	.92	-7.70
Caucasian (reference category)			
African American*	-.03	.97	-2.96
Other*	1.18	3.26	225.44
Arrests	.41	1.04	50.68
Detentions*	.43	1.54	53.73
Alcohol related arrests	-.01	.994	-.60
Drug related arrests	.10	1.10	10.51
Alcohol Scale	-.07	.93	-7.25
Drug Scale	.02	1.01	2.02
Violence Scale*	.13	1.14	13.88
Distress Scale	.07	1.07	7.25
Adjustment Scale*	.75	2.12	111.70
Stress Coping Abilities Scale*	.04	1.04	4.08
Log likelihood	-5248.45		
χ^2	163.2		

*p<.001

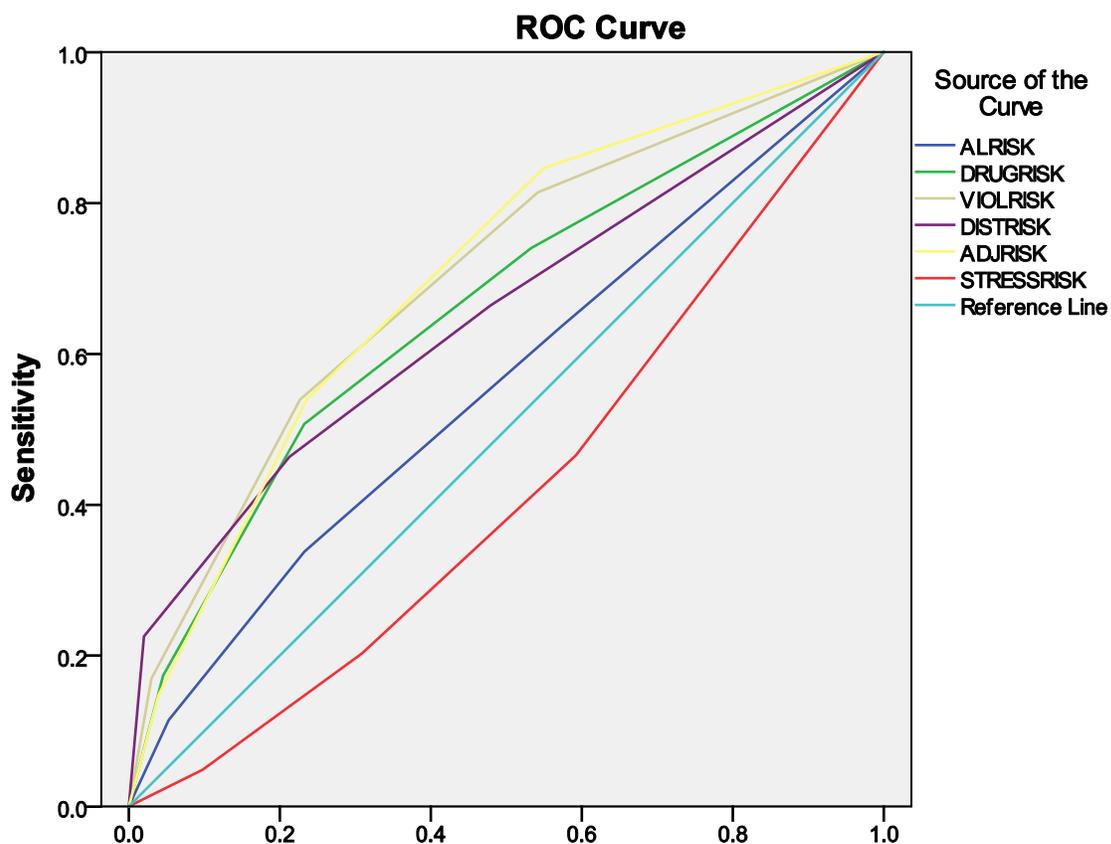


Figure 1. ROC for ACIDI-Corrections Version II risk classifications for each of the scales.

Table 2. Correlations

	Probation Revocations	Arrests	Alcohol Arrests	Drug Arrests	Alcohol Scale	Drug Scale	Violence Scale	Distress Scale	Adjustment Scale	Stress Coping Scale
Probation Revocations	1									
Arrests	.42**	1								
Alcohol arrests	.04**	.03**	1							
Drug arrests	.20**	.25**	.07**	1						
Alcohol Scale	.13**	.10**	.36**	.11**	1					
Drug Scale	.23**	.26**	.07**	.42**	.45**	1				
Violence Scale	.23**	.49**	-.15**	.07**	.13**	.27**	1			
Distress Scale	.21**	.21**	-.08**	.02	.15**	.22**	.46**	1		
Adjustment Scale	.19**	.19**	-.07**	.02*	.16**	.28**	.54**	.71**	1	
Stress Coping Scale	-.08**	-.10**	.09**	.02*	-.07**	-.16**	-.45**	-.67**	-.66**	1

** significant at $p = .01$; * significant at $p = .05$

