The development of early onset, chronic, and versatile offending: The role of fetal alcohol spectrum disorder and mediating factors

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ABSTRACT:

Background: There are several different hypothesized pathways that identify patterns of risk/protective factors concerning the development of adolescent chronic and violent offending. An under-researched and lesser understood pathway concerns how fetal alcohol spectrum disorder (FASD) is related either directly to the development of offending or indirectly to other criminogenic risk factors that contribute to offending and as well as negative health outcomes. *Objective:* Explore developmental and offending outcome differences between FASD and non-FASD youth. *Methods:* Ordinary least square and logistic regression analyses used to compare incarcerated Canadian FASD (n = 58) and non-FASD (n = 456) youth on measures of offending and risk factors associated with offending. *Results:* Incarcerated youth with FASD were more likely to experience a variety of outcomes considered to be risk factors for offending, including placement in foster care, having a comorbid behavioral disorder, having low self-control, a negative self-identity, and an earlier age of first alcohol use. *Conclusions:* Although FASD was also related to an earlier onset of offending and more frequent offending, these relationships were not evident once other key risk factors were included in multivariate analyses. Very importantly, this suggested that FASD youth were only at risk of early and frequent offending if they first had experienced other negative outcomes. Recommendations are made relating to interventions that can be implemented to reduce risk of youth with FASD experiencing other criminogenic factors.

Keywords: Adolescent offenders; FASD; intervention; public health; risk factors

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Introduction

It has been hypothesized that there are at least five pathways to adolescent serious and violent offending (SVOs), which include a prenatal risk factor pathway, a personality disorder pathway, an extreme child temperament pathway, a childhood maltreatment pathway, and an adolescent-onset pathway (1). These distinctive pathways have several important criminal justice system policy and public health implications. For the former, one of the most fundamental challenges has been devising and implementing effective intervention policies/programs to reduce recidivism. As well, SVOs frequently have been a major public health concern because their developmental pathways to offending, not uncommonly, are characterized by several physical and mental health risk factors, which also negatively affect their

general social functioning. These risk factors include substance abuse, different forms of abuse including physical, sexual, and neglect, family poverty and disruption, and mental health disorders. Fetal alcohol spectrum disorder (FASD) is one mental health disorder that is so strongly over-represented among offender populations that it has been hypothesized to represent the SVO prenatal risk facto pathway (1). Like other pervasive developmental disorders, FASD is a complicated phenomenon; however, its etiology is less controversial because it is directly caused by the toxic effects of ethanol concentrations in alcohol on the development of the fetal brain. Frequent consumption of higher amounts of alcohol or binge drinking during the second trimester of pregnancy are two ways in which the likelihood of FASD is increased. Given that FASD too is a spectral disorder, its developmental impact on SVOs is very likely varied and mediated by other risk and protective factors.

In Canada and other countries with substantial Aboriginal and First Nations populations (e.g., Australia and New Zealand), FASD is a fundamental health and mental health policy issue (2). Although FASD is not easily diagnosable, primarily because current tests are time consuming and costly, FASD has been reported to be disproportionately present among Aboriginal youth in both Canada (2) and Australia (3). Another policy theme is that FASD has likely been under-diagnosed for a variety of reasons but primarily because of resource limitations. It is difficult to obtain and validate prevalence estimates across different countries; yet few health officials in countries such as Canada, Australia, New Zealand, and the United States deny that FASD is a critical public health concern, generally, and for youth and adult criminal justice systems, in particular.

In this study, a sample of incarcerated adolescent offenders (n = 514) were asked whether they had been told they had been diagnosed with FASD. File data also was utilized to assess or support the FASD assertion, though, this data too was subject to incomplete reporting. Additional criminogenic risk factors, including abuse, substance use, placement in foster care, and low self-control, were included to examine whether these factors mediated the relationship between FASD and different criminal offending outcome measures. As well, both criminal justice and public health systems' FASD-related costs were considered.

Outcomes Associated with FASD

FASD has been causally related to neuro-cognitive deficits involving executive functioning, behavioral regulation problems, learning, and other mental and physical health problems (e.g., 4; 5).Nonetheless, the prevalence of FASD diagnoses in general

populations has been estimated to be very low.[1] Sampson et al. (6), for example, estimated that less than 1% of live births were afflicted with some form of alcohol-related neuro-developmental disorder. In effect, FASD does not appear to be a pervasive social/health issue. However, in countries such as Canada, the prevalence of FASD within certain criminogenic sub-populations (e.g., youth on probation) has been estimated to be as high as 30% (7), and similarly high among youth in forensic inpatient centers (8). Given its estimated prevalence in youth (especially Aboriginal youth) in criminal justice and mental health systems (9; 10), FASD constitutes a serious policy challenge in several ways.

The relationship between FASD and involvement in criminal behavior is neither simple nor direct. Unlike other disorders such as psychopathy, the antisocial and criminal behavior of youth with FASD has not been reported to be instrumentally motivated (e.g., planned with the understanding of the full negative and long term impact of the harm) or ‘cold-blooded’ acts of harm. Typically, FASD neurocognitive deficits have involved social inappropriateness and impulse control. However, a profile of these deficits for an unspecified proportion of FASD individuals has been associated with both minor/moderate criminal behavior and, for an estimated even smaller number, SVOs. In other words, theoretically it is not yet understood to what degree FASD is associated with the profile of social interaction deficits that might be the primary explanation of adolescent SVOs. The theoretical challenge is complicated because, from a developmental criminological perspective, all pervasive developmental disorders are mediated by numerous and multi-level risk and protective factors (11; 12). More recently, Corrado and Freedman (1) specified a distinctive multivariate risk pathway from FASD to offending. This pathway was based on several theorized relationships implied in the limited research on FASD deficits and their interactions with other traditional criminological-based risk factors such as family parenting styles and poor school performance. Further, these interactions between FASD deficits and other risk factors were considered to be cumulative across developmental stages into early adulthood. This cumulative disadvantage describes a process where each subsequent negative outcome further reduces protective factors and increases the likelihood of an individual experiencing other negative outcomes, including criminal behavior (e.g., 13).

In addition to the hypothesized association between FASD and criminal behavior, FASD has also been associated with other negative outcomes, including antisocial peers, substance use, impulsivity, and aggressive behavior (e.g., 5; 14; 15; 16). As the above Corrado and Freedman (1) pervasive developmental pathway asserted, FASD youth

were hypothesized to be more likely to be placed in foster care or group homes in response to their family's inability to ensure the essential and basic welfare of their child (see also 14). Very importantly, substance use commonly contributed to the family of origins inability to provide basic care for their child. In other cases, even without the negative contribution of substance use, an additional factor that compromises parenting ability is the high level of caregiver stress brought on by the challenging behavior of a child or youth with FASD (17). Paradoxically, although placement in foster care has commonly been used in response to families struggling to provide care of their FASD child, foster care has also been recognized as a risk factor for offending (18).

Again, depending on the types and extent of permanent neurocognitive and other deficits caused by FASD, certain FASD youth typically require long-term specialized school programming, family financial support, health/mental health specialized resources, and, not uncommonly, for extremely aggressive or violent youth, either in-home care/supervision or long-term foster care placement. In many Canadian provinces, the latter intervention options have involved culturally appropriate child-in-care programs, most frequently for Aboriginal children/youth. Yet, these well-intended policies have been difficult to implement because of the extensive and coordinated resource needs of the multiple ministries/agencies that are required for the placement families, especially for FASD cases (19). Public health care, education, housing, and even employment programs for older FASD youth therefore are essential at the individual case planning level to prevent, or at least mitigate, the FASD related negative outcomes/risk factors that increase the likelihood of serious and life course criminal trajectories.

In Canada, for example, the total annual cost of responding to youth with FASD was over half a billion dollars (2). At the individual level, the life course program costs for each person with FASD has been estimated at approximately 1.5 million dollars (20). Arguably, the lack of the above appropriate treatment/intervention programs have been a major cause of the enormous expenditures, especially for FASD adolescents sentenced, first, to custody and, second to adult custody. One important policy in Canada has been the increased use of posters in public places including schools and health facilities to educate youth about the risk of FASD, generally and binge drinking, particularly. Many First Nations have emphasized this approach to educating their youth. A second effective program has been public health home nurse visits to alert pregnant mothers about FASD as well as healthy fetal development. However, one challenge for these programs has been related to difficulties in reaching youth who

have been socially isolated (e.g., youth who drop out of school or Aboriginal youth who do not access First Nations and or Band reserve facilities) (18).

It is important to reiterate that, although the cause of FASD is indisputable, the causal pathway to serious criminal trajectories remains theoretically speculative. Negative labeling of FASD youth obviously needs to be avoided, particularly for Aboriginal youth already stigmatized by negative stereotypes based on alcohol. This study focused on incarcerated serious and violent young offenders as part of a preliminary attempt to assess the hypothesized negative outcomes associated with (a) FASD and (b) the development of early onset, chronic, and versatile criminal offending. This research is seen as an essential step in providing public health officials with information concerning specific factors that, hopefully, could be helpful in specifying further prevention programming for a particularly vulnerable FASD sub-group.

Method

Sample

Male and female incarcerated adolescent offenders (n = 514) were interviewed in custody facilities in British Columbia, Canada between 2005 and 2011 as part of the Incarcerated Serious and Violent Young Offender study. The sample, therefore, is very specific (e.g., Canadian, adolescents, incarcerated offenders), which could limit generalizability to other national jurisdictions. For example, approximately 30% of offenders in the current study were Aboriginal, which is dissimilar from most incarcerated samples in the United States where African American and Hispanic youth are disproportionately represented (21). Additionally, all offenders were incarcerated at the time of their interview; consequently, they likely differed from other young offenders who received a less punitive sentencing option (e.g., probation). The participants' ages ranged from twelve to nineteen. The distribution of ages across Aboriginal and non-Aboriginal ethnicities is outlined in Table 1.

--Insert Table 1 about Here--

Procedure

Informed consent was provided by the British Columbia Ministry of Children and Family Development (MCFD). MCFD served as the legal guardian to all youth in custody, and their consent allowed this project to approach all youth in various custody centers throughout the province during the study period. Youth were approached on their unit within the custody centre and asked if they wanted to participate in a

research study for Simon Fraser University. All subjects were read and given a copy of an information sheet and consent sheet explaining the purpose of the study, how information would be collected (e.g. interview and file information), and that all information would be kept confidential by law, with the exception of the subject making a direct threat against themselves or someone else. Youth who agreed to participate in the study were asked to sign a consent form signifying that they had been read and understood the details of the study.

Research assistants (RAs) were granted access to each subject's case management file, which contained subjects' pre-sentence reports and other background information. If subjects had been diagnosed with FASD, this information likely was in their case management file, which facilitated the reliability of FASD-disclosed interview information. For example, in a non-confrontational manner, RAs routinely asked their interview subjects who did not report having been diagnosed with FASD about their responses when their file information had indicated otherwise.

Measures

FASD. To be identified as a youth with FASD, subjects were asked if they had ever received a diagnosis of FASD or suspected diagnosis of FASD. Subjects who thought they had FASD, but asserted that they had not been told as such by a mental health professional were not included in the FASD category. Generally self-report mental health diagnoses are not preferred, primarily because youth likely might not be aware of such diagnoses. FASD assessments, though, are particularly rigorous and time consuming. Therefore, assumedly, it is more likely that youth would be aware of an FASD diagnosis. Again, to help corroborate self-reported FASD diagnoses, subjects' file information was reviewed, including the youth probation officer's pre-sentence reports that contained the youth's medical history and any FASD diagnoses. As mentioned above, if file information indicated a subject had FASD, but the subject did not report FASD during their interview, RAs would follow up with subjects to address this omission. Moreover, pre-sentence reports routinely were presented in court, which further increased the likelihood that the youth would be aware of their diagnoses. Eleven percent of subjects reported being diagnosed with FASD. Despite RA procedures to enhance accuracy of reporting, it is very likely that the approximately one-tenth figure is an under-representation of the proportion of youth in custody with FASD.

There are several potential explanations for this apparent under-representation. One is related to the youth being unaware of any such diagnosis. Although FASD assessments

are rigorous, the ability to recall such assessments may be at a diminished level for youth with severe symptoms of FASD. Second, as mentioned above, FASD assessments are time-consuming and also costly and therefore are not routinely conducted. Also, anecdotally, over several decades First Nation and Aboriginal leaders in British Columbia as well as health officials have expressed persistent concerns with the lack of health and diagnostic resources regarding FASD assessment and treatment. The lack of resources being allocated to Aboriginal communities despite individuals within these communities being at greater risk for FASD (2; 3) may also contribute to the apparent under-representation of the proportion of youth in custody with FASD within this sample.

Demographic Characteristics: Youth were asked to self-report their age, ethnicity, and gender.

Criminogenic Factors. A number of hypothesized negative outcomes related to FASD and offending outcomes were examined. Low self control was a composite variable that included measures of risk taking, temper, and preference for physical rather than cognitive processes (Cronbach's alpha = .67). Positive self-image (Cronbach's alpha = .75) was measured using the youth's perceptions of their self-identity on the Schneider Good Citizens Scale (22). Subjects were also asked if they had been placed in foster care at some point in their life. Substance use was measured based on the age the subject began using alcohol. Abuse was measured based on self-reports of physical and sexual abuse. 'Other' behavioral disorders were disorders youth self-reported as being diagnosed with and included ADD/ADHD, ODD, and CD.

Offending Outcomes: Self-report information was collected regarding subjects' criminal history. Criminal versatility was measured based on youth's self-reported involvement in violations of court orders, drug trafficking, car theft, stalking, theft from person, theft from household, threatening, assault, assault with a weapon, robbery, murder, attempted murder, manslaughter, and criminal negligence causing death (Cronbach's alpha = .75). Offending frequency was measured based on subjects' self-reported number of times arrested. Age of offending onset was based on the age the subject had first been incarcerated.

Analytic Strategy

The analysis focused on exploring the hypothesis that traditional criminogenic factors mediated the relationship between FASD and different offending outcomes. All offending outcomes were interval-level variables; therefore, the main analyses relied

on ordinary least squares (OLS) regression. To assess this hypothesis, three criteria needed to be satisfied. First, there must be a relationship between FASD and criminogenic factors. Second, there must also be a relationship between FASD and offending outcomes. Third, the inclusion of criminogenic factors in the multivariate OLS model must negate the relationship between FASD and offending outcomes. After presenting the descriptive statistics, the first analysis in this study entered criminogenic factors as outcome variables as part of either a multivariate OLS or logistic regression analysis (depending on the level of measurement of the risk factor), which were predicted by FASD, controlling for demographic characteristics. The criminogenic outcomes were then entered into a stepwise OLS model in order to evaluate whether these factors mediated the relationship between FASD and offending outcomes.

Results

FASD (n = 58) and non-FASD (456) youth were compared in Table 2 on demographic characteristics, offence history, and the various hypothesized outcomes of FASD mentioned above. Depending on the outcome's level of measurement, comparisons were made using either chi-square analyses or *t*-tests. Generally, risk factor outcomes were more commonly associated with FASD youth compared to non-FASD youth. No risk factors were significantly more likely to be associated with non-FASD youth. Subjects with FASD were also more likely to be incarcerated at an earlier age and have a greater number of arrests compared to subjects without FASD. These initial results suggest that, not only is FASD associated with earlier and more frequent offending, it is also associated with several other risk factors discussed above that impair health and general functioning.

--Insert Table 2 about Here--

To examine whether the associations described above remained significant when controlling for demographic factors, a series of ordinary least-squares (OLS) and logistic regression analyses were conducted (see Table 3). For interpretation of the odds ratios, non-FASD, non-Aboriginal, and female were treated as the reference group for their respective variables. Youth with FASD and Aboriginal youth were significantly more likely to have been placed in foster care and to have a comorbid behavioral disorder. Although fully explaining the four outcome variables in Table 3 was not an aim of the current study, the AUC values indicated that FASD and demographic variables significantly accounted for the variance in foster care placement, physical abuse, sexual abuse, and having a behavioral disorder.

--Insert Table 3 about Here--

The results of the OLS regression analyses are indicated in Table 4. Having FASD significantly increased scores on the study's low self-control scale. Youth with FASD were also more likely to begin using alcohol at an earlier age. Adjusted R^2 values were relatively low; however, like the logistic regression analysis, the purpose of this analysis was to explore the relationship between FASD and different outcomes and not to try to explain these outcomes more fully. In the next analyses, FASD and the outcomes associated with FASD were included in OLS regression analyses to examine their relative contributions to the explanation of criminal offending.

--Insert Table 4 about Here--

In Table 5, stepwise OLS regression was conducted for three different offence-related outcome variables. For each of the outcome variables, in the first step (Model 1), FASD and demographic factors were included. In the second step (Model 2), various risk factors hypothesized to be related to be (a) outcomes of FASD and (b) predictors of offending were included. The inclusion of additional predictor variables in step two resulted in significant improvements in R^2 values for each of the three offending-related outcomes. Looking at Model 1 for each of the three offending outcomes, FASD was a significant predictor of having a greater number of arrests and an earlier age of first incarceration. However, within Model 2 for the respective offending outcomes, once additional explanatory variables were added to the model, FASD was no longer a significant predictor of any of the three offending outcomes. Instead, being placed in foster care, having low self control, and having an early age of alcohol use were most consistently associated with the different offending outcomes.

--Insert Table 5 about Here--

Discussion

The primary focus of this research was to assess the hypothesis that criminogenic factors mediate the relationship between FASD and three offending outcomes: criminal versatility, age of onset of offending, and offending frequency. To verify a mediating relationship required that three criteria be established: (1) FASD is associated with criminogenic factors, (2) FASD is associated with the offending outcome of interest, and (3) the inclusion of criminogenic factors negates the association between FASD and the offending outcome of interest. The results presented here can be considered in

support of Corrado and Freedman's (1) hypothesized pathway from FASD to criminogenic factors to early onset and persistent offending.

Adolescent incarcerated offenders with FASD were found to be more likely than other incarcerated adolescent offenders to experience several criminogenic factors including placement in foster care, having a comorbid behavioral disorder, having high levels of low self-control, and having an earlier age of onset of alcohol use. This satisfies the first criterion for establishing a mediating relationship. For the second criterion, FASD was found to be associated with early onset and frequent offending but not criminal versatility. Given there is no relationship between FASD and criminal versatility, it cannot be expected that criminogenic factors mediate this relationship. For the third criterion, FASD was no longer related to early onset and frequent offending once other criminogenic factors were accounted for. Thus, criminogenic factors, in particular being placed in foster care, low self-control, and early onset alcohol use, mediate the relationship between FASD and early onset and frequent offending.

From a criminal justice perspective, these findings provide justification for optimism that the criminal activity of FASD youth very likely can be prevented or at least mitigated by early intervention programs directed at the relationship between the above criminogenic risk factors and FASD. Identifying the appropriate intervention strategies is beyond the scope of the current study; however, several general themes will be briefly discussed.

Policy Implications

Most encouragingly, notwithstanding the obvious challenge for children with FASD to develop prosocial behaviours despite their significant emotional and cognitive deficits, it is, at least, tentatively apparent that there is very likely enormous variability in the relationship between FASD and serious criminal offending. This reinforces the importance of initial perinatal education and health programs designed to prevent or possibly moderate certain negative outcomes associated with FASD. Public health systems likely have to intensify programs that identify families, and particularly mothers, at risk for frequent alcohol use and/or dependency. Focus should specifically be given to young teenage mothers from historically marginalized income groups and/or ethnic/racial groups. Clearly, intergenerational poverty and abuse has been associated with enormous vulnerability of mother to self-medicate, especially in coping with health challenges that accompany pregnancy. A recent study, for example, has reported a 13 IQ point drop for mothers under extreme stress caused by poverty that,

in turn, affects their ability to engage in positive parenting practices and related problem solving (23).

Family income supplement programs and daycare resources, including routine access to specialized early childhood education resources, are obvious policies that can reduce daily stress levels and, therefore, potentially increased parental abilities to provide a structured environment for their FASD children. Very importantly, child-in-care programs likely require specialized foster care placements (e.g., families that receive specific training and related professional mental health assistance on a routine basis). As discussed above, multiple child-in-care placements have been identified as a risk factor for serious criminal offending, therefore, it appears important to avoid exposing FASD children and youth to its disruptive impacts. For many older FASD adolescents, group homes and subsidized independent living also can enhance prosocial life styles. These specialized resources are needed throughout the life course to reduce (a) the likelihood of early criminogenic risk factors, which left unattended, result in cumulative deficits/disadvantages that lead to serious criminal trajectories, and (b) to avoid adolescent and adult onset criminogenic risk factors including antisocial peer groups, street lifestyles, and alcohol and drug abuse.

Finally, greater research resources are needed to develop less time and cost consuming diagnostic instruments. Several promising technologies including brain imaging and genetic/epigenetic testing have emerged for other pervasive developmental disorders such as Autistic Spectral Disorder (24), which could be relevant as well for FASD. In addition, life course comprehensive risk/protective factor case management instruments such as the Cracow Instrument can provide for the systematic identification of needs profiles that better address the complicated comorbidity challenges associated with FASD (25).

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Table 1: Demographic characteristics of the sample†

	Aboriginal (n = 163)	Non-Aboriginal (n = 349)	Full Sample (n = 514)
	% (n)	% (n)	% (n)
Male	84.7 (138)	88.0 (307)	86.6 (445)
Female	15.3 (25)	12.0 (42)	13.4 (69)
Age 12	0.6 (1)	0.9 (3)	0.8 (4)
Age 13	2.5 (4)	4.6 (16)	3.9 (20)
Age 14	11.7 (19)	9.7 (34)	10.5 (54)
Age 15	23.3 (38)	16.9 (59)	18.9 (97)
Age 16	28.2 (46)	26.6 (93)	27.2 (140)
Age 17	28.8 (47)	31.8 (111)	30.7 (158)
Age 18	4.9 (8)	8.0 (28)	7.0 (36)
Age 19	0.0 (0)	1.4 (5)	1.0 (5)

† Chi square measures of association revealed no differences between Aboriginal and non-Aboriginal youth on any of the measures included in the table.

Table 2: Comparison of characteristics of FASD and non-FASD youth offenders

	FASD Offenders (n=58)	Non-FASD Offenders (n=456)	χ^2/*t*, *p*, *Φ*/*d*
	m (sd)/% (n)	m (sd)/% (n)	
Demographic Characteristics			
Aboriginal	54.4 (31)	29.0 (132)	$\chi^2(1) = 15.03$, $p < .001$, $\Phi = .171$
Male	84.5 (49)	86.8 (396)	*n.s.*
Age	15.7 (1.3)	16.0 (1.3)	*n.s.*
Criminal History Factors			
Criminal Versatility	8.3 (2.7)	7.7 (2.8)	*n.s.*
Number of Times Arrested	4.4 (2.3)	3.4 (2.1)	$t(504)=-3.33$, $p < .01$, $d= .30$
Age at First Incarceration	13.8 (1.6)	14.5 (1.7)	$t(505)=2.87$, $p < .01$, $d= .26$
Individual-Oriented Risk Factors			
Placed in Foster Care	85.7 (48)	52.9 (240)	$\chi^2(1) = 21.89$, $p < .001$, $\Phi = .207$
Positive Self Identity	66.3 (10.7)	69.4 (10.1)	$t(498)=2.19$, $p <.05$, $d= .20$
Low Self Control	7.9 (3.2)	6.6 (3.5)	$t(505)=-2.57$, $p <.05$, $d= .23$
Sexual abuse	16.4 (9)	11.3 (51)	*n.s.*
Physical abuse	56.4 (31)	43.0 (194)	*n.s.*

‘Other’ Behavioral disorder	84.2 (48)	64.3 (292)	$\chi^2(1) = 9.00$, $p < .01$, $\Phi = .13$
Age of Alcohol Use	10.5 (3.0)	11.4 (2.7)	$t(504)=2.26$, $p < .05$, $d = .20$

Table 3: Logistic regression models predicting offending risk factors

	Placed in Foster Care	Sexual Abuse	Physical Abuse	‘Other' Behavioral Disorder
Item	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
FASD	4.5 (2.0-9.9)***	1.4 (0.6-3.3)	1.6 (0.9-2.9)	3.2 (1.5-6.8)**
Aboriginal	2.0 (1.3-3.1)**	1.8 (1.0-3.4)	1.3 (0.9-2.0)	0.7 (0.4-1.0)*
Male	0.5 (0.3-1.0)*	0.1 (0.1-0.2)***	0.2 (0.1-0.4)***	1.1 (0.6-1.9)
Age	0.8 (0.6-0.9)***	0.9 (0.7-1.1)	1.1 (1.0-1.3)	0.9 (0.7-1.1)
-2 Log ML	635.8	294.5	656.4	634.1
χ^2, (df), p	59.8 (4), ***	73.2 (4), ***	36.1 (4), ***	15.7 (4), **
Cox and Snell R^2	0.11	0.14	0.07	0.03
AUC (95% CI)	.69 (.64-.73)***	.59 (.53-.64)**	.63 (.58-.68)***	.59 (.54-.64)**
Note. $^{*}= p < .05$; $^{**}= p < .01$; $^{**}= p < .001$				

Table 4: OLS regression models predicting offending risk factors

	Positive Self Image	Low Self Control	Alcohol Use Age of Onset

Item	B (95% CI)	B (95% CI)	B (95% CI)
FASD	-2.7 (-5.5 - 0.1)	1.1 (0.1-2.1)*	-0.9 (-1.7-0.1)*
Aboriginal	0.1 (-1.8-2.0)	-0.2 (-0.9-0.5)	-0.2 (-0.7-0.2)
Male	-2.5 (-5.1-0.1)	-0.2 (-1.1-0.8)	-0.2 (-1.0-0.5)
Age	1.7 (1.0-2.4)***	-0.1 (-0.4-0.1)	0.3 (0.1-0.5)**
F, (df), *p*	9.5 (4), ***	1.8 (4), *n.s.*	4.1 (4), **
Adjusted R^2	0.06	0.01	0.02
Note. *= $p < .05$; **= $p < .01$; **= $p < .001$			

Table 5: Stepwise OLS regression models predicting offending risk factors

	Criminal Versatility		Number of Times Arrested		Age First Incarcerated	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Item	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)
FASD	0.6 (-0.2-1.4)	-0.1 (-0.8-0.6)	1.0 (0.4-1.6)**	0.5 (-0.1-1.2)	-0.6 (-1.0--0.1)*	-0.3 (-0.7-0.2)
Aboriginal	0.0 (-0.6-0.5)	0.1 (-0.4-0.5)	-0.2 (-0.6-0.2)	-0.1 (-0.5-0.3)	.02 (-0.1-0.5)	0.1 (-0.2-0.4)
Male	-0.6 (-1.4-0.1)	-0.8 (-1.5--0.1)*	0.0 (-0.5-0.6)	0.1 (-0.6-0.7)	0.2 (-0.2-0.6)	0.2 (-0.2-0.7)
Age	-0.1 (-0.3-0.1)	0.0 (-0.1-0.2)	0.0 (-0.2-0.1)	0.1 (-0.1-0.2)	0.6 (0.5-0.7)***	0.5 (0.4-0.7)***
Placed in Foster Care	.	0.3 (-0.1-0.8)	.	0.7 (0.3-1.1)**	.	-0.7 (-1.0--0.4)***

Sexual Abuse	.	-0.4 (-1.2-0.3)	.	-0.2 (-0.8-0.4)	.	-0.1 (-0.6-0.4)
Physical Abuse	.	0.5 (0.0-1.0)*	.	-0.2 (-0.6-0.2)	.	0.2 (-0.1-0.5)
'Other' Behavioral Disorder	.	0.6 (0.1-1.1)*	.	0.4 (0.0-0.8)	.	-0.1 (-0.4-0.2)
Positive Image	.	-0.1 (-0.1-0.0)**	.	0.0 (0.0-0.0)	.	0.0 (0.0-0.0)
Low Self Control	.	0.3 (0.2-0.3)***	.	0.1 (0.0-0.1)**	.	-0.1 (-0.1-0.0)***
Alcohol Age of Onset	.	-0.1 (-0.2-0.0)*	.	-0.1 (-0.2-0.0)**	.	0.1 (0.0-0.1)**
F, (df), *p*	1.5, (4), *n.s.*	13.7, (11), ***	2.9 (4),*	5.8, (11), ***	34.7, (4), ***	18.6, (11), ***
Adjusted R^2	.00	.23 $^{\Delta}$	.02	.10 $^{\Delta}$	.23	.30$^{\Delta}$
Note. *= $p < .05$; **= $p < .01$; **= $p < .001$; $^{\Delta}$ Indicates change in R^2 value increased significantly ($p < .001$) from Model 1.						

Footnotes

1. However, official diagnoses of FASD likely underestimate the actual prevalence of FASD. FASD diagnoses are both complex and costly. Moreover, in Canada and Australia, FASD is often over-represented in rural Aboriginal communities. ↩