# Long-term Follow-up of Criminal Activity with Adjudicated Youth in Ontario

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**ABSTRACT**

This article examines the criminal trajectories and childhood and adolescent risk factors of trajectory group membership in a sample of 386 adjudicated youth in Ontario. Participants had served a sentence at one of two open custody facilities in Toronto, over an 11-year period, between 1986 and 1997. Criminal offending, based on official records, was tracked for 16.4 years, on average (*SD* = 4.1, range = 9.8 – 28.7 years), from late childhood/early adolescence into their early 30s. Childhood and adolescent risk and protective factors reflecting individual, family, peer, and school domains were extracted from client files. Seven trajectories fit the sample. Results of the multinomial regression analyses indicated that early antisocial behaviour and poor academic achievement in childhood and poor family relations, involvement in alternative care, and poor academic achievement in adolescence differentiated the low risk desisters from the moderate and high rate offence trajectories. Implications for early intervention and prevention programs and further research are discussed.

**Keywords**: group-based trajectory analysis; juvenile offenders; risk factors; prevention

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### The cost of crime

Crime imposes substantial costs on society. In 2003, Canada spent approximately $13 billion on their criminal justice system (Department of Justice, 2005). Recent information puts the 2011 U.S. Department of Justice (DOJ) budget at $29.2 billion, $8.3 billion of which is for correctional facilities (Office of Management and Budget, 2010). Cohen and Piquero (2007) estimate the lifetime cost of a single career criminal to be $2.6 to $4.4 million (USD). This includes costs for prosecution, incarceration, attempts at treatment and rehabilitation, loss of productivity for victims and offenders, as well as victims' costs of pain, suffering, and diminished quality of life.

For alcohol and drug-involved crimes, Miller, Levy, Cohen, and Cox (2006) found the total cost to be $205 billion (USD) when factoring in victimization costs of pain, suffering, and diminished quality of life alongside the costs of justice services, public services (e.g., police services), and medical and mental health care expenses. In Canada, Leung (2004) calculated the cost of pain and suffering from crime to be either $9.83 billion or $35.83 billion, depending on the source of the victimization data (UCR versus GSS victimization survey). Cohen, Rust, Steen, and Tidd (2004) used a novel approach to estimate the cost of crime, based on the "contingent valuation" (CV) methodology employed in other fields, such as environmental economics. CV is used "to place dollar values on nonmarket goods such as improvements in air quality, saving endangered species, and reducing the risk of early death" (p. 91). Cohen et al. conducted a representative, nationwide survey of 1,300 U.S. residents to determine the public's willingness to pay (WTP) for crime reduction programs. Using the WTP estimates and aggregating across five offence types (burglary, armed robbery, serious assaults, rape and sexual assaults, and murder),

they determined the cost to be $625 billion (USD), which is considerably higher than previous estimates, but is thought to be more representative of the social costs of crime because it takes into consideration such factors as the fear of crime.

With respect to youth crime, based on data from the 500 youth in the Pittsburgh Youth Study (PSY), Welsh, Loeber, Stevens, Stouthamer-Loeber, Cohen, and Farrington (2008) estimated the financial burden to be between $89 million and $110 million (USD). In terms of government expenditures for the juvenile justice system, McMurtry and Curling (2008) reported that Ontario had an $850 million youth justice budget and a $163 million budget for youth custody. More recently, in 2008-2009, the per diem rate for a bed in a secure custody facility for youth in Ontario was about $470 or $171,550 a year; the per diem rate for a bed in an open custody facility $260 or $94,900 a year[1]. In 2008-2009, there were 754 secure and 513 open custody beds for youth in Ontario (Ministry of Children and Youth Services, 2010). In other ways, the less tangible social costs of loss of social cohesion in a low-income neighbourhood, personal costs of a child growing up with a parent incarcerated, and family costs of grieving the loss of a child to a life of crime are impossible to quantify, making the true cost of crime incalculable.

**The value of prevention and early intervention**

It has long been recognized that a small proportion of individuals are responsible for a disproportionate number of crimes. Wolfgang, Figlio and Sellin (1972) reported that 6% of their Philadelphia cohort accounted for 50% of the criminal acts to age 17. More recently, Welsh et al. (2008) reported that 10.2% of their sample from the PSY accounted for 50.1% of all self-reported offences. Chronic offenders begin their criminal activity at an early age and persist into adulthood, commit both serious and violent crimes, and pose a considerable challenge to the

criminal justice system (Piquero, Farrington, and Blumstein 2003). Implementing sound targeted prevention and early intervention programs makes good economic sense and holds the greatest promise for crime reduction. Indeed, using data from the Second Philadelphia Birth Cohort (Tracy, Wolfgang, and Figlio, 1990), Cohen, Piquero, and Jennings (2010) estimated that the financial burden of the small group of high rate chronic offenders identified in their study (3.1% of the sample) was nearly half the total cost of offending for the entire sample. They reported that the most expensive offender in their sample (an individual on a high rate chronic trajectory) "imposed a cost of $35,406,000 on society" (p. 296).

Economic analyses have shown that even a modest decrease in crime through effective crime reduction efforts can yield considerable savings (Aos, Phipps, Barnoski, and Lieb, 2001; McCollister, French, and Fang, 2010). Miller et al. (2006) reported that a 10% reduction in alcohol and drug-involved crime could save $4.25 billion (USD). In terms of cost savings, for every dollar spent by the High/Scope Perry Preschool Program, an early childhood education program in Ypsilanti, Michigan, the program repaid $17.06 (USD), which includes the costs in savings for criminal activity (Nores, Belfield, Barnett, and Schweinhart, 2005; Schweinhart, 2007). In other words, participation in this program yielded participants with higher lifetime earnings, a lower burden on welfare support, and lower rate of criminal activity, compared to participants in a control group. Lastly, the Multisystemic Therapy program (MST), an intensive program for high risk and delinquent youth, yields $13.36 (USD) in benefits to public safety for every dollar spent (Aos et al., 2001).

Emerging evidence also suggests that the greatest gains from crime prevention efforts come from targeting those individuals with the highest risk factors (Dodge and McCourt, 2010; Welsh and Farrington, 2007). This was the conclusion reached by Foster, Jones, and the Conduct

Problems Prevention Research Group (2006) when they evaluated the cost-effectiveness of the Fast Track prevention program for at-risk children in first through tenth grade. Using incremental cost-effectiveness ratios (ICERs), an index of the costs of the program relative to the outcomes, they determined that, for the group at lowest risk at intake, the ICER was negative and the effectiveness probability was 6%, indicating that the program was neither cost effective nor likely to be effective with this group. By contrast, for the group at highest risk at intake, the estimated ICER was found to be $752,103 (less than the $1 million threshold) and the effectiveness probability was 99%, indicating both cost-effectiveness and a high likelihood of being effective with this group.

**Targeting high risk children and youth**

A challenge for any targeted (i.e., indicated or selected) prevention or early intervention program is to be able to identify those individuals most at risk of the maladaptive outcome, such as a life of crime (Cohen et al., 2010; LeBlanc, 1998; Lochman, 2006). Considerable efforts have been expended over past decades to identify the factors that are most strongly associated with the onset and maintenance of criminal behaviour (Leschied, Chiodo, Nowicki, and Rodger, 2008). These efforts have informed the development of myriad programs for children and youth aimed at preventing or forestalling the onset of antisocial activity by strengthening protective factors and reducing the impact of risk factors, some of which have been shown to be highly effective (Farrington, 2007). However, further work needs to be done to identify individuals who show risk factors associated with the most serious, protracted, and highest rate criminal careers.

Longitudinal studies that track criminal activity over time, ideally across major developmental periods such as adolescence and adulthood, and are able to identify, prospectively or retrospectively, early risk factors associated with serious (i.e., high rate, chronic) offending

could aid the development of targeted intervention and prevention strategies. Longitudinal studies have the advantage over other methodologies such as cross-sectional research, of tracking within-individual developmental pathways and of identifying how life events are associated with change and continuity across the life course. Moreover, recent advances in person-centered statistical analyses have enabled longitudinal researchers to examine within-individual change over time as well as to identify distinct patterns of within sample offending behaviour (i.e., age-crime trajectories).

One of these statistical techniques is the group-based trajectory analysis (Nagin, 2005). Group-based trajectory analysis is a specialized application of finite mixture modelling (McLachlan and Peel, 2000) that allows the researcher to identify clusters of individuals whose pattern of offending is statistically similar as it unfolds over time. The objective of this analytical tool is to uncover the inherent latent heterogeneity in the nature and pattern of criminal offending *across individuals*, as the course of the behaviour is charted over time *within individuals*. Once individuals are sorted into discrete trajectory groups, regression analysis (or other statistical approaches) is applied to identify the best set of developmental predictors (i.e., risk and protective factors) that differentiates the groups. Childhood and adolescence variables, reflecting various life domains (e.g., individual, family, peer, school, and neighbourhood), are recorded, which are then subjected to the analysis. In this regard, group-based trajectory analysis may be well-suited to identify risk factors that could be targeted in early intervention and prevention programs (Cohen et al., 2010)[2]. The next section briefly reviews the literature on group-based trajectory analysis.

**Literature review on group-based trajectory analysis**

The criminology field has widely embraced group-based trajectory analysis since its advent about 15 years ago. Piquero (2008) identified over 80 studies that have used these statistical techniques. As a review of all these studies is beyond the scope of this paper, select findings will be highlighted with a particular emphasis on risk factors representing the most serious offence trajectories.

Across studies, the number of trajectory groups yielded varies from as few as two (Yessine and Bonta, 2009) to as many as eight (Thornberry, 2004), though four to six is typical (Piquero, 2008). The four trajectory groups from the Fergusson, Horwood, and Nagin (2000) study are illustrative of the overall findings: (1) Nonoffenders (55.3%); (2) Moderate Rate Offenders (30.8%); Adolescent Onset Offenders (7.6%); and Chronic Offenders (6.3%). Reasons for differences in the number of trajectory groups include sample characteristics, methodological design, the number of time points for assessment, and outcome variable definition.

Comparisons across trajectory groups on offending-related variables indicate that groups differ in terms of the average age of onset, length of the criminal trajectory, peak age of offending, and number of offences committed. Moreover, studies that use community samples commonly identify a nonoffender group, which often comprises the majority of individuals in the sample (e.g., Piquero, Farrington, and Blumstein, 2007). Studies with offender samples typically identify a low rate (e.g., near-zero) trajectory group, which often comprises the largest group in the sample. For example, Bersani, Nieuwbeerta, and Laub (2009) found that 70% of their offender sample fell into the low rate group.

In addition to identifying a nonoffender or low rate group, the other end of the trajectory group spectrum reports a high rate chronic trajectory group, generally constituting 3% to 10% of

the sample, irrespective of sample characteristics. There is now a growing body of literature that has examined predictors and correlates of these trajectory groups. As noted, this literature might prove useful in identifying early risk factors of high rate chronic offenders, for whom targeted early intervention and prevention programs might be developed, as well as the particular risk and protective factors that could be targeted by the intervention.

Nineteen studies were identified that examined both trajectory groups and predictors/correlates of trajectory group membership. With regard to the relations between risk factors and trajectory groups, some studies have reported dose effects such that high rate groups evince the worst risk factors (e.g., the greatest number), low rate groups show the most favourable backgrounds, including the most protective factors, and moderate rate groups fall somewhere in between (e.g., Fergusson et al., 2000; Maldonado-Molina, Piquero, Jennings, Bird, and Canino, 2009; Sampson and Laub, 2003; van Domburgh, Loeber, Bezemer, Stallings, and Stouthamer-Loeber, 2009). Other studies have not reported dose effects but rather reported on differences for discrete variables such that specific risk factors were associated with particular trajectory groups (e.g., Ward, Day, Bevc, Sun, Rosenthal, and Duchesne, 2010; Wiesner and Windle, 2004). Table 1 summarizes the specific risk factors associated with serious offence trajectories. Identified risk factors were those that were unique to the high rate chronic group and were distinguished from the low rate or nonoffender group, such as identified through a multinomial regression analysis in which the reference group was the low rate or nonoffender group (cf. Wiesner and Windle, 2004; Wiesner and Capaldi, 2003 who used their high rate group as the reference group). These comparisons were often the most robust with regard to finding group differences, though such comparisons (i.e., of extreme groups) also will lead to an overestimation of the strength of the relationship for that risk factor (Farrington, 2005a).

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Table 1 about here

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As presented in Table 1, high rate chronic offenders comprised between 3.1% and 24.2% of the samples. Examination of the predictors/correlates of the high rate chronic group indicate that a range of variables falling across a number of domains (i.e., individual, family, peer, school, and environmental) characterize individuals on the most serious offence trajectory. Individual factors identified through these studies included early conduct problems and attention problems, aggressive behaviour, older age at first offence, adjustment problems, male gender, sensation seeking, depression, suicidality, substance abuse/dependence, risky sexual behaviour, psychosocial immaturity, Indigenous status, and non-Western ethnic background. Family factors included family adversity, authoritarian parenting, poor parental monitoring and supervision, low parental empathy, negative labels applied by the parents to the child, family contact with a child welfare agency, and criminal family members. Peer factors included association with a delinquent or deviant peer group and high peer tolerance of deviance. The school factor was poor academic achievement. Environmental factors included social disadvantage, exposure to community violence, and availability of drugs.

While drawing firm conclusions from this diverse body of literature is difficult, it is evident that no single risk factor or set of risk factors clearly emerges as the most salient predictor of high rate chronic offending. Rather, a range of variables falling across a number of domains contribute to the emergence of a high rate chronic offender. This is consistent with the notion of equifinality. Note that these findings reflect, to some extent, the particular theoretical focus of the study or the number of risk factors and life domains included in the analyses. For

example, whereas some studies examined a broad range of risk factors that relate to multiple life domains (e.g., Chung, Hill, Hawkins, Gilchrist, and Nagin, 2002; Piquero, Farrington, and Blumstein, 2007; van der Geest, Blokland, and Bijleveld, 2009; Ward et al., 2010; Wiesner and Silbereisen, 2003), other studies focused on a narrow range of variables or had a limited theoretical focus (e.g., Hoeve, Blokland, Semon Duas, Loeber, Gerris, and van der Laan, 2008; Monahan, Steinberg, Cauffman, and Mulvey, 2009).

Moreover, consistent with developmental theories of antisocial behaviour (e.g., Patterson, DeBaryshe, and Ramsey, 1989; Moffitt, 2993; Thornberry, 2005), it is suggested that these factors likely exert their influence at different stages of development. For example, Chung et al. (2002) asserted that the effect on serious criminal offending of family adversity experienced in childhood would be mediated through peer, school, and neighbourhood factors in adolescence. In other words, the impact of distal factors will be mediated by variables more proximal to the event (i.e., criminal behavior). Moreover, Wiesner and Capaldi (2003) reported that family factors in childhood, specifically punitive and inconsistent parenting and low parental supervision, and deviant peer associations in adolescence were both uniquely associated with a chronic, high level offence trajectory. They interpreted this pattern of results as suggesting that, whereas family factors in childhood were associated with the *onset* of criminality in the chronic high level group, peer factors in adolescence were associated with the *maintenance* of this offence trajectory. Clearly, there is a need for more research to identify the unique risk factors associated with chronic high level offenders. As well, there is a need to better understand the factors influencing the onset and persistence of crime at different developmental stages, such as childhood and adolescence, from the individual, family, peer, and school domains.

**The present study**

The present study extends our previous work with this population (Ward et al., 2010) with an alternate subsample of offenders employing a longer follow-up period. Our previous research examined the criminal trajectories of a subsample of 378 youth from this population who had resided at one of two open custody facilities, between 1986 and 1996, operated by a children's mental health centre. In that study, criminal trajectories were examined over a 12.1 year (on average) follow-up period, up to March, 2001. The trajectory analyses yielded four groups, labeled low rate (LR), moderate rate (MR), high rate adolescence peaked (HRADOL), and high rate adult peaked (HRADL). In terms of risk factors, we found that, in childhood, involvement in alternative care was associated with the HRADOL and HRADL groups and experiencing a broken home/family transitions was associated with the MR group, compared to the LR group. In adolescence, criminal family members were associated with the MR, HRADOL, and HRADL groups and involvement with alternative care was associated with the HRADOL and HRADL groups, compared to the LR group. Additionally, in adolescence, poor peer relations was associated with the LR group (compared with the MR and HRADOL), and familial abuse was associated with the LR group (compared with the HRADL group). These findings highlighted the role of family factors in childhood and criminal family members and continued involvement in alternative care in adolescence as key predictors of serious offence trajectories. By contrast, delinquent peer associations and family abuse in adolescence were associated with a low rate offence trajectory.

The present study examined criminal trajectories and predictors/correlates of trajectory group membership with a different subsample from this population, with a 16.4 year (on average) follow-up. With the longer follow-up period, we expected to find a greater number of

trajectory groups in the model than previously found. With regard to risk factors, we expected that early family dysfunction and involvement in alternative care and criminal family members in adolescence would similarly predict the high rate chronic offenders. Additionally, like our previous work, the present study contributes to the growing body of literature on criminal trajectories in four ways: (1) it uses a known offender sample of Canadian-based youth; (2) it examines criminal trajectories across the major developmental periods of adolescence and adulthood; (3) it uses an extended criminal follow-up period; and (4) it uses a broad range of predictor variables across various life domains that differentiates between childhood and adolescent risk factors.

## METHOD

### Sample

The study sample comprised 386 male offenders who had served a youth sentence between 1986 and 1997, at one of two open custody facilities operated by a children's mental health centre in Toronto, Canada. This sample represents a 50% random selection of all youth who had been sentenced to the two facilities during this period. Results for the other half of this population were described in Ward et al. (2010).

### Criminal data

Official records for juvenile and adult offences were obtained from the (Ontario) Ministry of Correctional Services (MCS), the Canadian Police Information Centre (CPIC), and Predisposition Reports (PDR) from the client files maintained by the children's mental health centre. Three data sources were used to ensure a high degree of completeness and accuracy for the sequenced, longitudinal offending data, which is essential for research that requires an accurate temporal sequencing of criminal activity (Smith, Smith, and Norma, 1984). Official

records were appropriate for our purposes because they provide the requisite precision with regard to both the timing and sequence of offending as well as offenders' movement data into and out of the custody settings.

From these sources, counts by age of all unique court contacts arising from a new set of charges[3] were recorded to September 26, 2007, the end of the follow-up period. The criminal count data were adjusted for both time-at-risk (Eggleston, Laub, and Sampson, 2004) and an estimate of the offenders' age at offence rather than at court contact (Farrington, Coid, Harnett, Jolliffe, Soteriou, Turner, and West, 2006). For the age adjustment, we modelled the time lag as a random unknown quantity, following an exponential distribution, whose mean value of 157.6 days was estimated from supplementary data obtained from the Metropolitan Toronto Police Service (MTPS) (see Day, Bevc, Duchesne, Rosenthal, Rossman, and Theodor, 2007 for details on these adjustments).

The criminal activity for this sample was tracked for an average of 16.4 years (*SD* = 4.1, range = 9.8 – 28.7 years), from late childhood/early adolescence[4] into adulthood. Their mean age at first court contact was 15.6 years (*SD* = 1.6) and the sample was 32.0 years (*SD* = 4.0, range = 26.3 – 40.2 years) at the end of the follow-up period. The average trajectory length, defined as the difference in years between the first and last court contact, was 9.5 years (*SD* = 5.6). During the tracking period, the sample accounted for a total of 4,657 court contacts, an average of 12.1 court contacts per individual.

**Risk factors**

Personal and background information was extracted from client files maintained by the children's mental health centre that operated the open custody facilities. Of a possible 386 client files, 350 files were reviewed and coded. The remaining 36 files could not be located, possibly

due to lost or incomplete files or an alternative storage location. Documents that were reviewed for coding included intake forms, PDRs, psychological and psychiatric reports and notes, discharge summaries, and other pertinent sources of information on file such as case notes, social work reports, and police synopses.

In order to differentiate the childhood (i.e., birth to 12 years) from adolescent (i.e., 13 to 19 years) variables, two sets of coding schemes were developed, one for each developmental period. The coding schemes were designed to include as much relevant information from the client files as possible[5]. Selection of the variables was based on a comprehensive review of the theoretical and empirical literature and reflected four life domains: individual, family, peer, and school. The coding schemes were essentially the same as those used in the Ward et al. (2010) study, with the addition of four risk factors (noted below).

In the individual domain, risk factor variables included hyperactivity-impulsivity-inattention, antisocial behaviour, alcohol and/or drug use, callousness, lack of responsibility or accountability for bad behaviour, health problems, low self-esteem, and extra-familial sexual abuse, immigrant status, death of a caregiver, homelessness, and suicidality (the latter four items were added for this study). In the family domain, variables included criminal family members, parental psychopathology, poor child-rearing methods, familial abuse, relationship difficulties among family members, broken home/family transitions (e.g., parental separation or divorce, change in caregivers, frequent moves), involvement with alternative care (e.g., institutional or foster care, child welfare), and if the biological mother was age 17 years or younger at the time of childbirth. The peer domain included one risk factor, poor peer relations (i.e., peer rejection, antisocial peer associates). The school domain included two factors, poor academic achievement and poor regard for school (i.e., truancy, expulsions, suspensions). Although the childhood and

adolescent coding schemes overlapped on most items, there were some areas of divergence. For example, only the childhood coding scheme included the item of whether the biological parent was under the age of 17 at the time of the offender's birth and only the adolescent coding scheme included the items concerning callousness, lack of responsibility for bad behaviour, homelessness, and suicidality. Coding for the risk factors was dichotomous, such that 0 = "absent/unknown" and 1 = "present/suspected."

The coding was conducted by a research assistant who was unaware of the trajectory group membership assignments. Inter-rater reliability was conducted by two independent raters using 20 files, representing a 5.6% randomly selected sample of files. Inter-rater reliability was found to be moderate to good (Landis and Koch, 1977) with average Kappas of .77 for the childhood variables and .70 for the adolescent variables, respectively.

**Data analysis**

The data analysis proceeded in three stages. First, using *crimCV*, a software program developed for our research program[6], we fit the data with a latent class zero-inflated Poisson (ZIP) model with different numbers of K classes. A ZIP (Lambert, 1992) model using the so-called ZIP (τ) parameterization was used for the latent sub-populations to account for the relatively large number of zero court contacts in the data set. Conditional on an individual being a member of class k the expected number of criminal events $\mu_j^k$ at age j is given by

$$\mu_j^k = \left(1 - q_j^k\right)\lambda_j^k$$

where

$$\log\left(\frac{q_j^k}{1 - q_j^k}\right) = -\tau^k \log\left(\lambda_j^k\right)$$

with $q_j^k$ being the probability of individuals in class k being criminally inactive at age j and

$$\log(\lambda_j^k) = \beta_0^k + \beta_1^k j + \beta_2^k j^2 + \beta_3^k j^3$$

with $\lambda_j^k$ the rate of court contacts for an individual in group k and criminally active at age j. All parameters **θ** were estimated by the method of maximum likelihood under the assumption that, within the trajectory groups, the number of court contacts of those in a criminally active state at age *j* followed a nonhomogeneous Poisson process with rate parameter $\lambda_j^k$ (Jones, Nagin, and Roeder, 2001). Trajectory group membership was based on the highest individual posterior probability associated with each trajectory group.

Selection of the number of groups that best fit the data is conventionally based on the Bayesian Information Criterion (BIC). However, it is known that the BIC provides a somewhat problematic solution to the number of groups issue (Nagin, 2005). As an alternative method, we use cross-validation (Hélie, 2006; Stone, 1974), specifically, *leave-one-out cross-validation.* This method provides a fair, objective, and unambiguous means of assessing the number of groups and avoids the limitations, ambiguities, and subjectivity that may arise with the BIC (Day et al., 2007). The cross-validation measures the accuracy of the fit for individual *i* by using estimates of the model parameters $\theta^{(-i)}$ based on data for all the *other* individuals but not individual *i* for all observed subjects. This approach validates the model by assessing its ability to predict observed data values using the remaining data. The advantage of cross-validation is that it provides a fair measure of how appropriate the chosen group number K is for the given data, in terms of how accurately a model with that number of groups is able to predict the offender data. A large cross-validation error (CVE) indicates that the model with K groups is not a good statistical model for this data. A small CVE indicates the model with K groups is doing a good job of predicting offender data. The cross-validation criterion for number of groups then involves simply choosing the value of K that minimizes CVE.

Next, given the large number of risk factors, a two-step approach eliminated variables for entry into the multinomial regression analyses. First, variables were excluded that had either a base rate of 10% or less or zero cell counts across the trajectory groups. Second, following the procedure outlined by Hosmer and Lemeshow (2000), each of the remaining variables was entered into a univariate multinomial regression analysis to assess its appropriateness in the model. This was done by examining the impact of the presence and absence of each risk factor on the overall goodness-of-fit and chi-square Likelihood Ratio Test (LRT) statistic. A risk factor was retained if the corresponding chi-square LRT statistic was statistically significant at $p < .25$ (Hosmer and Lemeshow, 2000). Last, backward stepwise multinomial logistic regression analyses were performed on the final set of background variables to determine the relationship between the best combination of risk factors and the trajectory groups. Backward stepwise regression is a useful procedure when important factors have not been identified and when the association between the risk factors and outcome variables are not well understood (Hosmer and Lemeshow, 2000). SPSS 17.0 was used for the regression analyses.

## RESULTS

### Trajectory analysis

As shown in Table 2, the BIC and AIC values continued to increase as the number of groups increased. Hence, the BIC and AIC criteria both suggest at least an eight-group model and probably even more groups; for more than eight groups, the amount of computation required to fit the model and calculate the CVE is very high. However, the CVE was minimized for the seven-group model. Therefore, the cross-validation criterion clearly recommends choosing $K = 7$. Once we fix $K = 7$, we can then identify the most likely probability-based group membership

for each subject. Estimated criminal trajectories for the seven-group model are displayed in Figure 1.

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Table 2 about here

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Figure 1 about here

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The seven trajectory groups yielded by the analyses were heuristically labeled Moderate Rate Chronic I (MRC I), comprising 3.6% of the sample; High Rate Adult Peaked (HRADLP), comprising 3.9% of the sample; High Rate Adolescence Peaked (HRADOLP), comprising 4.4% of the sample; Moderate Rate Adolescence Peaked (MRADOLP), comprising 11.7% of the sample; Moderate Rate Chronic II (MRC II), comprising 14.2% of the sample; Low Rate Desister (LRD), comprising 29.8% of the sample; and Low Rate Chronic (LRC), comprising 32.4% of the sample. None of the groups had less than 10 individuals in them and the mean posterior probability coefficients were quite high across all four groups, exceeding .89.

Comparisons on relevant variables across the seven trajectory groups are shown in Table 3. As indicated in Table 3, the LRD group had, on average, the latest age at first court contact, the earliest age at last court contact, and the briefest criminal career. The HRADLP group had the earliest average age at first court contact and the MRC I had both the latest average age at last court contact and the longest average criminal career. Over the duration of their criminal trajectory, the HRADLP group had the largest average number of unique court contacts (adjusted by time-at-risk), with 78.1 ($SD$ = 41.5), accounting for 15.8% of the total number of court

contacts amassed by the sample, followed by the HRADOLP group with 62.7 (*SD* = 19.1), accounting for 14.3% of the total court contacts, and the MRC I group with 52.1 (*SD* = 16.0), accounting for 9.8% of the total court contacts. The LRD group had the fewest average court contacts, with 4.8 (*SD* = 3.2), accounting for only 7.4% of the total court contacts.

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Table 3 about here

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**Multinomial logistic regression analyses**

**Childhood model.** Five childhood risk factors were entered into the multinomial logistic regression model (see Table 4), including antisocial behaviour, poor child-rearing methods, family abuse, broken home/family transitions, and poor academic achievement. The overall model was significant ($\chi^2$ (12) = 23.95, $p$ = .02) with antisocial behaviour and poor academic achievement significantly contributing to the model (both $p$s < .05). The proportion of variance in trajectory group membership, as measured by the Nagelkerke pseudo $R^2$ statistic, was 6.9%. In order to determine the risk factors that distinguished low rate desisters from more active and persistent offending, the LRD trajectory group was assigned as the base reference group.

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Table 4 about here

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The results indicated that an early onset of antisocial behavior predicted the HRADLP and MRADOLP trajectory groups, in comparison to the LRD group. More specifically, the presence of early antisocial behaviour increased by a factor of 4.2 ($p$ < .05, 95% CI [1.16, 15.01]) and 3.3 ($p$ < .05, 95% CI [1.49, 7.51]) the risk of being in the HRADLP and MRADOLP

groups, respectively, compared to the LRD group. As well, poor academic achievement decreased by a factor of .36 the risk of being in the MRADOLP group, compared to the LRD group ($p < .05$, 95% CI [.13, .97]).

**Adolescent model.** Five adolescent risk factors were entered into the multinomial logistic regression model (see Table 5), including hyperactivity-impulsivity-inattention, antisocial behaviour, family relationship problems, involvement with alternative care, and poor academic achievement. The analysis yielded a significant model ($\chi^2$ (18) = 57.97, $p = .001$) comprised of three significant risk factors, family relationship problems ($p = .001$), involvement with alternative care ($p = .002$), and poor academic achievement ($p < .001$). The proportion of variance in trajectory group membership accounted for by these three factors, as measured by the Nagelkerke pseudo $R^2$ statistic, was 15.9%. Once again, the LRD trajectory group was designated as the base reference group.

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Table 5 about here

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The results indicated that family relationship problems predicted membership in the HRADLP, MRADOLP, and MRC II groups, compared to the LRD group. More specifically, experiencing family discord increased the risk of being in the HRADLP, MRADOLP, and MRC II groups by a factor of 4.0 ($p < .01$, 95% CI [1.08, 14.69]), 5.2 ($p < .01$, 95% CI [2.26, 12.14]), and 2.1 ($p < .01$, 95% CI [1.02, 4.21]), respectively, compared to the LRD group. As well, involvement in alternative care increased by a factor of 4.4 ($p < .05$, 95% CI [1.17, 16.80]), 3.4 ($p < .05$, 95% CI [1.04, 11.32]), and 3.9 ($p < .05$, 95% CI [1.58, 9.57]), the risk of being in the HRADLP, HRADOLP, and MRADOLP groups, respectively, compared to the LRD group. Last,

poor academic achievement decreased by a factor of .23 ($p < .05$, 95% CI [.05, .98]) and .20 ($p < .05$, 95% CI [.08, .51]), and .35 ($p < .05$, 95% CI [.16, .79]), the risk of being in the HRADLP, MRADOLP, and MRC II groups, respectively, compared to the LRD group, suggesting that academic difficulties were related to low rate and desisting offending rather than moderate or high rate and persistent offending.

## DISCUSSION

Using data from an offender sample of Ontario youth, group-based trajectory analysis and multinomial regression examined age-crime trajectories and predictors/correlates of trajectory group membership. The trajectory analysis identified a model with seven trajectory groups. As expected, this was larger than the number of groups identified in our previous research using a different subsample of juvenile offenders from this population (Ward et al., 2010). The larger number of groups may be, as suggested by Nagin and Tremblay (2005) and Piquero (2008), attributed to the longer follow-up period. This issue will be further examined as we continue to follow-up the first subsample of offenders with an additional six years of criminal data (up to September, 2007).

These trajectory results are generally consistent with other research (Marshall, 2006; Sampson, and Laub, 2003; van der Geest et al., 2009). With the exception of the LRD group, all groups continued their criminal activity into their mid 20s or 30s, with criminal career lengths exceeding 10 years from their first court contact in their mid teens. This is to be expected, as Piquero (2008) reported that offence trajectories typically show a gradual decline by the mid 30s. As the average age at the end of the follow-up of this study was 32 years, many in the sample may have "matured" out of their offending, although further follow-ups will likely show continued criminal activity for the small number of persistent offenders (Bersani et al., 2009).

In other ways, the groups may be distinguished in terms of both the shape and duration of their criminal trajectories. Four of the groups (MRADOLP, MRC II, LRD, and LRC), comprising 88% of the sample, peaked in their rate of offending within a few years after their first court contact, which declined steadily thereafter. This pattern reflects the classic age-crime curve. However, with the exception of the LRD group, which desisted on average three years after their first court contact, three of the groups continued to offend for another 7 to 13 years, into their mid 20s or beyond. Interestingly, the two high rate trajectory groups also showed a peak in offending, though at later ages, including 19 years (HRADOLP) and 22 years (HRADLP). Last, the MRC I group evinced both the most stable pattern of offending, though at a moderate rate, and the longest criminal trajectory. Indeed, the latter two groups (HRADLP and MRC I), which together comprised only 7.5% of the sample, are of particular concern because of either the length of their criminal trajectory or their very high rate of offending.

In terms of predictors of trajectory group membership, two childhood factors were associated with the HRADLP and MRADOLP groups, in comparison to the LRD group, early antisocial behaviour and poor academic achievement. The finding that a greater proportion of individuals in the HRADLP group showed early antisocial behaviour is consistent with considerable research on the relation between early onset conduct problem behaviour and later criminality (e.g., Chung et al., 2002; Moffitt, 1993; Patterson et al., 1989). For example, Fergusson et al. (2000) found that early conduct problems was the strongest factor to differentiate their four trajectory groups and clearly characterized individuals in the chronic offence group. The relation between early antisocial problems and the MRADOLP group is unclear, and requires further investigation. Perhaps the HRADLP and MRADOLP groups manifested different *types* of antisocial behaviour in childhood. The antisocial behaviour item

used in this study reflected a broad factor that included different types of conduct problem behaviours, including both overt and covert, such as physical aggression, verbal aggression, defiance, property damage, and stealing. This lack of differentiation may have masked some differences between the HDADLP and MRADOLP groups. Inspection of the specific behaviours included in this item suggested that more of the HRADLP group displayed anger and physical aggression and more of the MRADOLP group displayed lying, defiance, and verbal aggression. Hence, although both groups were distinguished from the LRD group, the specific manifestation of their early conduct problems appeared to be different between the HRADLP and MRADOLP groups. Chung et al. (2002) also found that physical aggression in childhood differentiated their chronic offence trajectory from their minor offending and nonoffending trajectory groups. Moreover, inspection of the types of crimes committed by the trajectory groups indicated that violent crimes accounted for 37.8% of the (unadjusted) total number of crimes committed by the HRADLP group, compared with 25.3% for the MRADOLP group and 28% for the sample average. By contrast, the MRADOLP did not show a predominant pattern in their offence types that could be distinguished from the entire sample. This would lend support to the notion that the HRADLP group comprises serious (in terms of offence types) and high rate offenders for whom intensive, multifaceted, and sustained early intervention and prevention efforts might be warranted.

With regard to the finding that individuals in the LRD group were overrepresented on poor academic achievement, compared to the MRADOLP group, Wiesner and Silbereisen (2003) also found low academic achievement to be associated with a low-level offence trajectory. We found in our previous research that individuals in the low rate offence trajectory group were not problem-free in their early years. Perhaps experiencing only the one risk factor served a

protective function for the LRD group, suggesting that academic problems, in the absence of other difficult life circumstances, may be associated with limited involvement in the criminal justice system, reminiscent of Moffitt's (1993) dual taxonomy theory which included the adolescence-limited (AL) group. Moreover, although we were not able to examine directly in the presence context, this group also may have experienced more protective factors than the other groups.

In adolescence, two family factors and one school factor were associated with the HRADLP, HRADOLP, MRADOLP, and MRC II groups, in comparison to the LRD group, family relationship problems, involvement in alternative care, and poor academic achievement. Once again, the LRD group was overrepresented in terms of poor academic achievement, although in this case, compared with the HRADLP, MRADOLP, and MRC II groups. Clearly, both in childhood and adolescence, poor achievement in school was identified as a significant risk factor for the low rate desisters, compared with both moderate and high rate offenders.

With regard to the family factors, individuals in the HRADLP, MRADOLP, and MRC II groups were overrepresented in terms of family relations problems, compared to the LRD group and, compared to the LRD group, a greater proportion of individuals in the HRADLP, HRADOLP, and MRADOLP groups were involved in alternative care (e.g., child welfare). The latter finding is consistent with our previous research that found involvement with alternative care during adolescence to be associated with high rate offending and highlights the role of child welfare involvement as a risk factor for high rate and persistent offending (Leschied et al., 2008; Nicol, Stretch, Whitney, Jones, Garfield, Turner, and Stanion, 2000; Ryan and Testa, 2005). The former finding is more difficult to explain as it does not accord with extant developmental models of offending (e.g., Patterson et al., 1989; Farrington, 2005b; Moffitt, 1993). It may be

that for the HRADLP group at least, family discord in adolescence was associated with the maintenance of offending rather than the onset of offending.

Related to the above point, a surprising finding concerned the MRADOLP trajectory group. This group showed an offence profile that was parallel to the HARDOLP group, though at a much lower rate. Moreover, this group experienced as many childhood (early conduct problems) and adolescent (poor family relations and involvement with alternative care) risk factors as the HRADLP group, yet their rate of offending was considerably lower (and involved a somewhat different crime mix, as noted previously). Given the presence of these risk factors, one would expect the rate of offending for the MRADOLP group to be as high as the HRADLP group. In other words, one could ask what other factors might have been acting on this group to suppress their rate of offending. One possibility is that the MRADOLP group experienced more protective factors in their childhood and adolescence than the HRADLP group, which were not detected in the present study. This speculation requires further study but also underscores the importance of examining protective factors alongside risk factors, an area of investigation that has received far less attention in the literature (Löesel and Bender, 2003). Protective factors are often studied in the context of abstaining or desisting from crime. However, they also may play a role in either suppressing the overall rate of offending or delaying the onset of offending.

**Limitations**

The present study had a number of limitations. First, the study was limited by problems inherent in any archival file review study. The study findings reflect the amount and quality of information that was accessible in the client files. Much of the childhood data, for example, came from retrospective accounts by key informants contained in the PDRs, documents that are prepared for the courts. Only the most salient factors may have received attention in these

reports, with less salient, but nonetheless equally important (i.e., in terms of explanatory power) factors given less attention. Second, the risk factor variables were coded as either "absent/unknown" or "present/suspected." Whether a factor was absent because the youth had not experienced it or because the factor was not mentioned in the documents on file could not be confirmed. Third, as noted by Davis, Banks, Fisher, and Grudzinskas (2004), the limited risk factor information available in the file reviews did not allow for a test of causal hypotheses about the processes leading to offending behavior, as suggested by current developmental theories. In this regard, it is important for future research to examine the complex, causal processes or mechanisms by which risk and protective factors exert their influence on the development and course of offending behaviour (Farrington, 2007). Such research would be highly informative to the development of prevention and early intervention programs. Fourth, although our coding scheme included both risk and protective factors, the low base rate of occurrence of the protective factors precluded an examination in the analyses. Last, our criminal data were based on official records and may have underestimated the full extent of the participants' criminal activity by not including less serious offences and/or offences that may not have come to the attention of the authorities.

Nonetheless, the present study contributes to the literature on trajectory analyses of criminal offending by identifying childhood and adolescent risk factors associated with trajectory group membership in a Canadian-based sample of offenders. Early conduct problems, particularly physical aggression, are associated with the high rate offence trajectory, in agreement with considerable theory and research and which has been a focus of prevention and early intervention programs (e.g., Augimeri, Farrington, Koegl and Day, 2007). As well, the present study highlighted the importance of studying protective factors in risk factor research.

Both sets of factors contribute to our understanding of the causes of criminality thereby supporting the targeting for prevention and early intervention.

## NOTES

[1]This information was provided to the first author on August 31, 2010 by the Effective Programming and Evaluation Unit, Operational Support and Effective Programming Branch, Youth Justice Services Division, Ministry of Children and Youth Services, Toronto, Ontario.

[2]A word of caution is warranted however, about moving too quickly to do "something to people *predicted to be* high-rate offenders" (Piquero, 2008, p. 52). Risk factors are meant to be understood as probabilistic not deterministic. Furthermore, there is the danger of reifying groups generated by a statistical procedure and acting upon them as if they were real entities. Last, risk-focused interventions and prevention strategies that are based on sound theoretical models, framed within a developmental and life course perspective (Farrington, 2005b), offer both the greatest likelihood of effectiveness as well as the ability to test causal models of development, thereby contributing to the advancement of the growing field of prevention science (Lochman, 2006).

[3]Unique court contacts included those that resulted in a conviction and disposition (e.g., secure or open custody, fine, etc.), including a suspended sentence; those that resulted in a finding of guilt but not a conviction (e.g., absolute or conditional discharge); and those that resulted in either a withdrawal of charges, stay of proceedings, or determination that the person was unfit to stand trial (e.g., due to cognitive competence). These latter types of court contacts, which involved neither a finding of guilt nor a conviction, only accounted for 6.5% of the total number of court contacts. Last, for 8.0% of the court contacts, the final status in the official records was "remand," and, as such, no specific outcomes were available.

[4]Offences committed under the age of 12 years were charges that occurred under the Juvenile Delinquents Act (JDA). Only nine court contacts occurred under the JDA and took place between 1979 and 1983. The remaining juvenile court contacts occurred under the YOA.

[5]The coding schemes included both risk and protective factors. However, due to a low rate of occurrence among the protective factors, these variables were dropped from the analyses and so are not reported on here.

[6]We are currently in the process of developing an R package of the *crimCV* software that will be available to the public on Comprehensive R Archive Network (CRAN) at http://cran.r-project.org/.

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Table 1

Trajectory Studies that Identify a High Rate Chronic Group with Predictors/Correlates

| Author(s) | Year | Sample | No. Groups | High Rate Group (offence variable) | Predictors/Correlates |
|---|---|---|---|---|---|
| Fergusson, Horwood and Nagin | 2000 | community | 4 | chronic (3.1%) (variety[1]) | early conduct problems; family adversity; social disadvantage |
| McDermott and Nagin | 2001 | community | 3 | Group 3 (4.6%) (frequency[2]) | delinquent peers; negative labels of the child by parents |
| Chung, Hill, Hawkins, Gilchrist, and Nagin | 2002 | community | 5 | chronic (7.0%) (seriousness[3]) | aggressive behaviour; poor family management; antisocial peers; poor academic achievement; community availability of drugs |
| Wiesner and Silbereisen | 2003 | community | 4 | high-level (14%) (frequency) | male gender; older age at Wave 1 of data collection; low parental monitoring and empathy; high peer tolerance of deviance |
| Wiesner, and Windle | 2004 | community | 6 | high-level chronic (6.4%) (frequency) | poor academic achievement; adjustment problems; unsupportive family; negative life events |
| Maldonado-Molina, Piquero, Jennings, Bird, and Canino | 2009 | community (Bronx)<br>community (San Juan) | 5<br>4 | Group 5 (1.3%) (variety)<br>none was found (variety) | sensation seeking; exposure to community violence |

| | | | | | |
|---|---|---|---|---|---|
| Davis, Banks, Fisher, and Grudzinskas | 2004 | high risk | 3 | high rate (12.1%) (frequency) | male gender; substance abuse/ dependence disorder |
| Piquero, Farrington, and Blumstein | 2007 | high risk | 6 | high rate chronic (2.5%) (frequency) | high level on composite environmental and individual risk factors |
| Hoeve, Blokland, Semon Dubas, Gerris, and van der Laan | 2008 | high risk | 5 | serious persisting (24.2%) (seriousness) | authoritarian parenting style |
| Wiesner, and Capaldi | 2010 | high risk | 6 | chronic high level (15.7%) (frequency) | attention problems; poor parental supervision; depressive symptoms; risky sexual behaviour; substance use; deviant peer group |
| Marshall | 2006 | offender | 6 | very high (.9%) (frequency) | Indigenous status |
| Livingston, Stewart, Allard, and Ogilvie | 2008 | offender | 3 | chronic (11.0%) (frequency) | Indigenous status; male |
| Bersani, Nieuwbeerta, and Laub | 2009 | offender | 4 | chronic (4.0%) (frequency) | none was found |
| MacDonald, Haviland, and Morral | 2009 | offender | 3 (violent) | high rate chronic (5.9%) (frequency) | delinquent peers |
| | | | 3 (nonviolent) | high rate chronic (14.0%) (frequency) | delinquent peers; substance abuse |
| Monahan, Steinberg, Cauffman, and Mulvey | 2009 | offender | 5 | persister (5.7%) (variety) | deterioration of anger suppression and impulse control |

| | | | | | |
|---|---|---|---|---|---|
| van Domburgh, Vermeiren, Blokland, and Doreleijers | 2009 | offender | 3 | high rate (7.0%) (seriousness-frequency[4]) | older at first offence; non-Western ethnicity |
| van der Geest, Blokland, and Biljeveld | 2009 | offender | 5 | high frequency chronic (5.9%) (frequency) | criminal family members; suicide attempts; delinquent peers |
| Yessine, and Bonta | 2009 | offender (Aboriginal) | 2 | chronic high (18.7) (seriousness-frequency) | delinquent peers; family dysfunction; substance use |
| | | offender (non-Aboriginal) | 2 | chronic high (12.3%) (seriousness-frequency) | problems with accommodation |
| Ward, Day, Bevc, Sun, Rosenthal, and Duchesne | 2010 | offender | 4 | high rate adult-peaked (7.7%) (frequency) | alterative care involvement; criminal family members |

*Note:* [1]Variety refers to the number of different antisocial/criminal behaviours committed at each time period. [2]Frequency refers to the total number of criminal behaviours/convictions at each time period. [3]Seriousness refers to the seriousness level of the most serious offence committed at each time period. [4]Seriousness-frequency uses a combination of frequency counts and seriousness ratings.

Table 2

LLIKE, BIC, AIC, and CVE Values for Number of Trajectory Groups

| No. of Groups | LLIKE | BIC | AIC | CVE |
|---|---|---|---|---|
| 1 | -1676.783 | 23363.57 | 23400.83 | 0.7807739 |
| 2 | -10197.414 | 20416.83 | 20498.80 | 0.6712001 |
| 3 | -9735.615 | 19505.23 | 19631.92 | 0.6581372 |
| 4 | -9561.060 | 19168.12 | 19339.52 | 0.6406352 |
| 5 | -9406.668 | 18871.34 | 19087.45 | 0.6235395 |
| 6 | -9321.148 | 18712.30 | 18973.13 | 0.6290606 |
| 7 | -9242.408 | 18566.82 | 18872.36 | **0.6159237** |
| 8 | -9195.662 | **18485.32** | **18835.58** | 0.6345287 |

*Note:* LLIKE is the log-likelihood of the fit; BIC is Bayesian Information Criterion; AIC is Akaike Information Criterion; CVE is cross-validation error. Boldface numbers indicate the optimal model.

Table 3

Mean (SD) Comparison Tests across Seven Trajectory Groups

| Variable | Trajectory Group | | | | | | |
|---|---|---|---|---|---|---|---|
| | MRC I[a] ($n$ = 14) | HRADLP[b] ($n$ = 15) | HRADOLP[c] ($n$ = 17) | MRADOLP[d] ($n$ = 45) | MRC II[e] ($n$ = 55) | LRD[f] (n = 115) | LRC[g] (n = 125) |
| Age at first court contact | $15.3_{ab}$ (2.3) | $14.3_{a}$ (1.6) | $15.0_{ac}$ (1.2) | $14.4_{a}$ (1.6) | $15.3_{ac}$ (1.5) | $16.4_{b}$ (1.3) | $15.8_{bc}$ (1.6) |
| Age at last court contact | $31.9_{a}$ (3.9) | $25.5_{bd}$ (3.7) | $28.5_{a}$ (3.6) | $24.6_{b}$ (3.4) | $30.1_{a}$ (3.6) | $19.5_{c}$ (1.8) | $27.0_{d}$ (3.8) |
| Criminal trajectory length in years | $16.6_{a}$ (4.2) | $11.1_{b}$ (3.9) | $13.5_{a}$ (3.7) | $10.2_{b}$ (3.7) | $14.7_{a}$ (3.9) | $3.1_{c}$ (2.2) | $11.1_{b}$ (3.7) |
| Total No.[h] court contacts | $52.1_{a}$ (16.0) | $78.1_{b}$ (41.5) | $62.7_{a}$ (19.0) | $26.0_{c}$ (12.4) | $27.3_{c}$ (7.2) | $4.8_{d}$ (3.2) | $9.7_{d}$ (4.1) |

*Note:* [a]MRC I = Moderate Rate Chronic I group. [b]HRADLP = High Rate Adult Peaked group. [c]HRADOLP = High Rate Adolescence Peaked group. [d]MRADOLP = Moderate Rate Adolescence Peaked group. [e]MRC II = Moderate Rate Chronic II group. [f]LRD = Low Rate Desister group. [g]LRC = Low Rate Chronic group. [h]Number of court contacts was adjusted for time at risk. All oneway analyses of variance are significant, $p < .001$. All values in rows with different subscripts are significantly different from each other at the .05 level using the Scheffe post hoc test.

Table 4

Multinomial Logistic Regression of Trajectory Group Membership as a Function of Childhood Risk Factors (Base Reference Group is the Low Rate Desister Trajectory Group)

| Comparison | Risk Factor | β | *SE* | Odds Ratio | Wald |
|---|---|---|---|---|---|
| MRC I[a] vs. LRD[b] | Poor academic achievement | 1.12 | .67 | 3.08 | 2.85 |
| | Antisocial behaviour | .10 | .66 | 1.11 | .02 |
| | Intercept | -2.57 | .45 | | 32.83*** |
| HRADLP[c] vs. LRD | Poor academic achievement | -1.20 | .85 | .30 | 2.01 |
| | Antisocial behaviour | 1.43 | .65 | 4.17 | 4.77* |
| | Intercept | -2.55 | .47 | | 29.97*** |
| HRADOLP[d] vs. LRD | Poor academic achievement | -.17 | .68 | .84 | .07 |
| | Antisocial behaviour | .40 | .62 | 1.47 | .41 |
| | Intercept | -2.04 | .36 | | 31.51*** |
| MRADOLP[e] vs. LRD | Poor academic achievement | -1.03 | .51 | .36 | 4.09* |
| | Antisocial behaviour | 1.21 | .41 | 3.35 | 8.59** |
| | Intercept | -1.28 | .27 | | 22.81*** |
| MRC II[f] vs. LRD | Poor academic achievement | -.55 | .46 | .58 | 1.42 |
| | Antisocial behaviour | .05 | .40 | 1.05 | .02 |
| | Intercept | -.62 | .21 | | 8.61** |
| LRC[g] vs. LRD | Poor academic achievement | .10 | .33 | 1.11 | .21 |
| | Antisocial behaviour | -.08 | .32 | .93 | .06 |
| | Intercept | .08 | .17 | | .21 |

*Note.* [a]MRC I = Moderate Rate Chronic I group. [b]LRD = Low Rate Desister group. [c]HRADLP = High Rate Adult Peaked group. [d]HRADOLP = High Rate Adolescence Peaked group. [e]MRADOLP = Moderate Rate Adolescence Peaked group. [f]MRC II = Moderate Rate Chronic II group. [g]LRC = Low Rate Chronic group.

*$p < .05$. **$p < .01$. ***$p < .001$

Table 5

Multinomial Logistic Regression of Trajectory Group Membership as a Function of Adolescent Risk Factors (Base Reference Group is the Low Rate Desister Trajectory Group)

| Comparison | Risk Factor | β | *SE* | Odds Ratio | Wald |
|---|---|---|---|---|---|
| MRC I[a] vs. LRD[b] | Poor academic achievement | .50 | .64 | 1.64 | .60 |
| | Family relationship problems | -.49 | .66 | .61 | .57 |
| | Involvement with alternative care | .57 | .69 | 1.76 | .68 |
| | Intercept | -2.29 | .46 | | 24.98*** |
| HRADLP[c] vs. LRD | Poor academic achievement | -1.49 | .75 | .23 | 3.94* |
| | Family relationship problems | 1.38 | .67 | 3.99 | 4.32* |
| | Involvement with alternative care | 1.49 | .68 | 4.43 | 4.79* |
| | Intercept | -2.83 | .56 | | 25.30*** |
| HRADOLP[d] vs. LRD | Poor academic achievement | .38 | .62 | 1.46 | .38 |
| | Family relationship problems | .16 | .58 | 1.18 | .08 |
| | Involvement with alternative care | 1.23 | .61 | 3.43 | 4.11* |
| | Intercept | -2.59 | .49 | | 28.13*** |
| MRADOLP[e] vs. LRD | Poor academic achievement | -1.61 | .48 | .20 | 11.24*** |
| | Family relationship problems | 1.66 | .43 | 5.23 | 14.86*** |
| | Involvement with alternative care | 1.36 | .46 | 3.89 | 8.73** |
| | Intercept | -1.76 | .35 | | 24.79*** |
| MRC II[f] vs. LRD | Poor academic achievement | -1.05 | .41 | .35 | 6.50* |
| | Family relationship problems | .73 | .36 | 2.08 | 4.11* |
| | Involvement with alternative care | .60 | .44 | 1.81 | 1.81 |
| | Intercept | -.83 | .26 | | 10.36*** |
| LRC[g] vs. LRD | Poor academic achievement | -.10 | .30 | .92 | .10 |
| | Family relationship problems | .46 | .29 | 1.58 | 2.54 |
| | Involvement with alternative care | -.32 | .38 | .73 | .68 |
| | Intercept | -.03 | .20 | | .02 |

*Note.* [a]MRC I = Moderate Rate Chronic I group. [b]LRD = Low Rate Desister group. [c]HRADLP = High Rate Adult Peaked group. [d]HRADOLP = High Rate Adolescence Peaked group. [e]MRADOLP = Moderate Rate Adolescence Peaked group. [f]MRC II = Moderate Rate Chronic II group. [g]LRC = Low Rate Chronic group.
*$p < .05$. **$p < .01$. ***$p \leq .001$

Figure 1

Estimated Criminal Trajectories for Seven-Group Model