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# Predicting health service use in antisocial children using the early assessment risk list for boys (EARL-20B)

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**Abstract**

**Purpose of the Study**: To examine the relationship between the Early Assessment Risk List for Boys (EARL-20B) total and item scores and the prevalence of health service use, disease and mental health status in a sample of antisocial boys, followed up between the ages of 12 and 21.

**Methods**: information contained in clinical files of 234 boys seeking treatment for conduct problems was used to rate each of the twenty EARL-20B risk factors (0-1-2) to yield total scores ranging between 0 and 40. Provincial health records were used to derive health outcome variables based on outpatient, emergency room and inpatient encounters, and to facilitate analyses based on ICD-9 disease categories and specific mental health diagnostic variables.

**Results**: significant associations were found between the EARL-20B total score and emergency room use, particularly for encounters due to accidents and injuries. Total EARL-20B scores also predicted mental and behavioural problems such as mood and anxiety disorders and disorders of childhood and adolescence. Using logistic and linear regression, several individual EARL-20B items were identified as significant predictors of these outcomes.

**Conclusions**: This study showed that the EARL-20B, initially designed to assess risk for later criminality in children, also predicted health and mental health outcomes previously shown in the literature to be associated with conduct disorder. Study findings support the addition of accident prevention and health promotion training and education in interventions targeted at antisocial children and their families.

**Keywords: conduct disorder, behavioural problems, risk assessment, health service use, mental health, disease**

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# Predicting health service use in antisocial children using the early assessment risk list for boys (EARL-20B)

## Introduction

In Criminology, it is often said that when it comes to addressing the problem of crime, all roads lead to prevention and early intervention: offering programs early in the lives of antisocial children is the most promising and cost effective way to prevent their involvement in criminal activities later in life. From this conclusion, it can also be said that the same roads lead directly back to David Farrington whose prolific body of work on risk and protective factors led to the creation of developmental crime prevention (DCP), not only as a conceptual framework, but as a policy imperative. His transformative texts on this subject include *Serious and Violent Juvenile Offenders: Risk Factors and Successful Interventions* (Loeber & Farrington, 1998), *Child Delinquents: Development, Intervention, and Service Needs* (Loeber & Farrington, 2001), *Saving Children from a Life of Crime* (Farrington & Welsh, 2007), *The Oxford Handbook of Crime Prevention* (Welsh & Farrington, 2014), and *What Works in Crime Prevention and Rehabilitation: Lessons From Systematic Reviews* (Weisburd, Farrington & Gill, 2016). David's work has repeatedly emphasized that high quality evaluations (i.e., randomized controlled trials, quasi-experimental studies) show the best promise of advancing evidence-based DCP initiatives. To this point, reviews of systematic reviews demonstrate that well-designed and rigorously evaluated programs can produce substantial positive treatment effects (e.g., Farrington, Gaffney, Lösel, & Ttofi, 2017; Weisburd, Farrington, & Gill, 2017) that translate into monetary cost savings over time. In the most recent review of cost-benefit evaluations of DCP programs, Koegl, Farrington and Welsh (2023) found that for every dollar invested, DCP programs returned benefits ranging between 35 cents to 32 dollars depending on the scope of outcomes analyzed. Although crime accounts for a substantial proportion of these savings (i.e., averting victim costs), antisocial children impose a substantial economic burden in other sectors such as healthcare, education, child welfare, addictions, and mental health (e.g., Crescenzi et al., 2024; Foster, Jones, & Conduct Prevention Research Group, 2005; Goulter et al., 2024; Rissanen et al., 2022; Romeo, Knapp, & Scott, 2006; Scott, Knapp, Henderson, & Maughan, 2001). It follows that crime prevention strategies that are grounded in restorative, holistic, non-punitive paradigms are capable of achieving monetary savings in these other domains as well (Dodge, 2008; Mackenzie & Farrington, 2015; Welsh & Farrington, 2007).

### *The Relationship between Conduct Disorder and Adverse Health Outcomes*

A substantial body of research reveals that conduct disorder is associated with a wide variety of negative health and mental health outcomes in both adolescence and adulthood. These include, but are not limited to an increased risk for: suicidal behaviours (Beautrais et al., 1996; Darke, Ross, & Lynskey, 2003; Wertz et al., 2018), tobacco, alcohol and cannabis use (Erskine et al., 2016; Kretschmer et al., 2014), illicit drug addiction (Fergusson, Horwood, & Ridder, 2005), anxiety and depression (Colman et al., 2009; Stringaris, Lewis & Maughan, 2014), psychotic and antisocial personality disorders (Erskine et al., 2016; Kim-Cohen et al., 2003; Sourander et al., 2005), antidepressant use (Lichtenstein et al., 2020), sexually transmitted diseases (Lin et al., 2021), and premature death (Shepherd, Shepherd, Newcombe and Farrington, 2009).

Using a prospective longitudinal study design in Dunedin, New Zealand, Odgers and colleagues (2007) evaluated 526 boys with a persistent pattern of antisocial behaviour to determine if they were more likely to experience adverse health outcomes between the ages of 7 and 32. Using Moffitt's (1993) developmental taxonomy of antisocial behaviour to construct comparison groups, their analyses revealed that the most severe "life course persistent" (LCP) boys had substantially increased odds of manifesting a wide range of health problems at follow up compared to boys with low levels of conduct problems. Looking at the three largest odds ratios, LCP boys were 25.6 times more likely to have a history of attempted suicide, 21.5 times more likely to be dependent on drugs, and were 18.7 times more likely to be hospitalized for a mental health condition. Rivenbark and colleagues (2018) repeated this analysis on the same sample but extended the follow-up period an additional six years to capture health service use up to age 38. They found that, compared to low conduct problem children, the LCP group accumulated three times as many of emergency department visits and 84% more health encounters resulting from injuries. In another study of 801 children aged 7 to 42 in Providence, Rhode Island, Paradis and colleages (2016) also used trajectory analysis to classify individuals into three antisocial behaviour risk groups (i.e., persistent, adolescent-limited, no problems). They found that the persistent group was more than twice as likely to suffer a serious injury (*OR*=2.16) or seek medical help in an emergency department (*OR*=2.38) during the preceeding year, compared to the no-problem group.

A review of the pediatric injury literature reveals that unintentional injuries are the leading cause of death among children and adolescents (e.g., Heron, 2021). Moreover, research shows that children with disruptive behaviour disorders in childhood such as ADHD, ODD and CD are more vulnerable to suffering injuries later in life (Brehaut, Miller, Raina, & McGrail, 2003; Bruce, Kirkland, & Waschbusch, 2007; Langley, McGee, Silva, & Williams, 1983). In a British birth cohort study, Jokela, Power, and Kivimäki (2009) assessed 11,537 children at ages 7, 11, and 16 and parental measures of externalizing behaviour problems with self-reported injuries at ages 23, 33 and 42. Their findings revealed that for every one SD increase in externalizing problems, there was a corresponding 10–19% increase in the rate of injuries at all follow-up ages. Agnafors, Torgerson, Rusner, and Kjellström (2020) examined administrative public health records in a Swedish population-based study of individuals from birth up to age 17. Their analysis showed that having a diagnosis of ODD/CD in childhood increased the odds of suffering a fracture or concussion by 45%. Lastly, Temcheff et al. (2023) compared 744 children who were assessed by their parents as having or not having conduct problems between the ages of 6 and 9. Controlling for gender, household income, and comorbid ADHD, they found conduct problems in childhood was the only significant predictor of subsequent injuries (e.g., fractures, burns, concussions, cuts) up to age 16.

Taken together, these studies demonstrate a heightened vulnerability among conduct-disordered children for adverse health outcomes later in life. It is important to acknowledge, however, that the aforementioned studies predominantly employed categorical, behavior-based constructs to predict health service use and their related clinical outcomes. Although antisocial behavior itself is a strong predictor of a variety of negative outcomes, its narrow focus limits our understanding of other potential explanatory, causal factors and mechanisms that could be contributing to these outcomes. A core feature of the DCP paradigm is the integration of evidence-based assessment and intervention strategies designed to address the broad spectrum of individual, family, peer, and contextual influences affecting at-risk children and their families. In this context, the books by David Farrington and colleagues referenced earlier offer a detailed compilation of risk factors that have consistently emerged as reliable predictors of antisocial behavior. Notably, this extensive body of research formed the empirical foundation and incentive for developing the Early Assessment Risk List for Boys (EARL-20B; Augimeri, Koegl, Webster, & Levene, 2001).

## The Early Assessment Risk List for Boys (EARL-20B)

The EARL-20B was developed to assess general risk for future antisocial behavior in clinic-referred boys aged 6-11 manifesting high levels of conduct problems. Along with its companion guide for girls (EARL-21G; Levene et al., 2001), the EARLs are the only multifaceted risk assessment tools targeted at this specific age group, although other risk assessment guides have been created to assess antisocial potential in children and adolescents. The most notable of these include the CRACOW for children under age six (Corrado & Freedman, 2011), the SAVRY for adolescents aged 12-18 (Borum, Bartel, & Forth, 2006), and the YLS/CMI for youth aged 12-18 in correctional settings (Hoge & Andrews, 2011).

The EARL-20B is grounded in the *structured professional judgement paradigm* which seeks to bridge the gap between scientific research on risk factors and front-line clinical practice (Haque & Webster, 2019; Hart, Douglas, & Guy, 2016). Its purpose is threefold: (1) to increase understanding of early childhood risk factors for future antisocial behavior; (2) to help clinicians working with antisocial children to construct risk assessment schemas using structured formats and defined variables; and (3) to assist in the creation of effective, evidence-based clinical risk management plans for high-risk boys and their families (Augimeri, Enebrink, Walsh, & Jiang, 2010). The EARL-20B contains 20 items, divided into three domains of risk: Family, Child, and Responsivity. Each individual risk factor is assessed as *not present* (0), *possibly present* (1), *or present* (2) to yield a total score between 0 (little to no risk) and 40 (extremely high risk). Although the total score is often used as a summary measure of risk, individual EARL-20B risk factors are typically used by clinicians to target specific areas of concern for treatment planning. The most comprehensive study of the EARL-20B to date examined its ability to predict future criminal offending a sample of 379 antisocial boys using official criminal records (Koegl, Farrington, & Augimeri, 2021). Results revealed significant associations between EARL-20B total scores and various measures of criminal offending between the ages of 12 and 20. Additional analyses on the same sample of boys further showed that higher EARL-20B scores predicted victim and criminal justice costs over the same follow-up interval (Koegl & Farrington, 2021).

## The Present Study

Given the strong link between conduct disorder, adverse health outcomes and childhood injuries, it was important to explore whether the EARL-20B could also be used to predict these outcomes. As noted earlier, previous studies have typically examined this association by using behavioural measures (e.g., conduct disorder) to predict future health service use. However, no research to date has operationalized a multidimensional risk assessment tool to predict such outcomes. This study therefore aimed to fill this gap by examining the association between EARL-20B total and individual item scores and a variety of health service use and disease outcomes using real-world, public health utilization data. The study had three primary objectives:

1) To explore the association between EARL-20B total scores and the prevalence and frequency of health service utilization and disease;
2) To evaluate whether the EARL-20B can predict specific mental health disorders; and
3) To determine whether individual EARL-20B items are significant predictors of these outcomes.

## Materials and methods

### *Participants*

EARL-20B assessments were derived from a retrospective coding of closed clinical case files for 379 boys who attended the Stop Now And Plan Under 12 Outreach Project (SNAP-ORP) in Toronto, Canada between 1985 and 1999. Housed within the Child Development Institute (CDI), the SNAP-ORP is a 12-week cognitive-behavioural program for children between the ages of 6 and 11 in conflict with the law (see Augimeri, Farrington, Koegl, & Day (2007); Farrington & Koegl (2015); Koegl, Farrington, Augimeri, & Day (2008) for descriptions and evaluations of the program, and Koegl, et al. (2021) and Koegl & Farrington (2021) for evaluations of the EARL-20B in relation to criminal outcomes).

At intake to the program, the average age of participants was 9.6 years (*SD* = 1.4, *range* = 6–11). Boys were referred to the program by a variety of sources, but most often this was the police (53%), followed by schools (12%), another CDI program (12%), child protection (11%), or another source (12%). The top five presenting problems prompting referral were disobedience (74%), stealing/theft (72%), assault/aggression (71%), lying (64%), and verbal aggression (51%). Most boys were living with a single parent at the time of admission (48.1%), followed by an intact family (27.4%), a reconstituted family (12.2%), a common-law relationship (7.2%), a guardian (2.7%) or another arrangement (2.4%).

### *EARL-20B Risk Assessments*

As noted earlier, the EARL-20B is divided into 20 factors, organized under three categories of risk: *Family*, *Child*, and *Responsivity* (Table 1). Six Family items assess parental influences, including nurturing, supervision, and available supports or stressors in the boy's immediate home environment. Twelve Child items focus on a range of individual characteristics related to academic performance, peer relationships, coping strategies, and the appropriateness of his behaviour and attitudes. The two Responsivity items focus on the boy's and family's history and willingness to engage with treatment interventions. Individual items are scaled so that higher scores are indicate higher risk. Each risk factor is rated on a three point scale as, *not present* (0), *possibly present* (1), or *present* (2) to produce a total risk score ranging from 0 to 40. To improve the accuracy of scoring, evaluators are encouraged to obtain and assess information from multiple agents (e.g., teachers, parents, caregivers, doctors) across multiple sources (e.g., clinical records, school reports, standardized tests). Prior research has shown that the EARL-20B has acceptable interrater reliability and validity (for summaries, see Augimeri et al., 2010; Koegl, Augimeri, Ferrante, Walsh, & Slater, 2008).

For this study, closed clinical case files were coded by three independent raters with advanced academic degrees and experience in the social sciences as part of the initial validation and reliability studies of the EARL-20B (Augimeri et al., 2010; Hrynkiw-Augimeri, 2005). EARL scores were derived from the totality of the clinical file which captured their 12-week timeframe of involvement in the SNAP-ORP program. Ratings were based on clinical notes, parental reports, standardized measures and information forms, case conference reports, reports from collateral agencies, child and parent group treatment progress reports and a SNAP program termination report. Scores for each of the 20 individual items (0, 1, or 2) were generated for each participant to yield a total maximum score of 40. Raters were blind to all outcome measures when they completed EARL-20B assessments.

### *Health Service Use, Disease, and Mental Health Outcome Data*

Access to health datasets was granted by the Institute for Clinical Evaluative Sciences (ICES), Toronto, Canada after receiving ethics approval from the Research Ethics Board at Sunnybrook Hospital. Health data are curated by ICES which has a mandate to perform epidemiological research that improves the health of Ontarians. These data encompass real-world, public health system service use events, as provided by the Ontario Ministry of Health and Long-Term Care and the Canadian Institute for Health Information (CIHI). Datasets housed at ICES contain patient-level data for the population of individuals who reside in Ontario, Canada. Five datasets were used to construct health service outcome and disease variables for this study.

**Registered Persons Database (RPDB).** The first step in constructing an aggregated health outcome dataset was to locate the 379 SNAP-ORP boys in the RPDB which contained roughly 16 million current and historical records of individuals residing in the province of Ontario. Personal identifiers (i.e., date of birth, surname, given names, postal code, and Ontario health card numbers) were transcribed from the SNAP-ORP clinical files. These identifiers were subsequently used with deterministic and probabilistic linkage algorithms that identified nearly all (*N*=365 or 96.4%) of the original study participants. Once matched, personal identifiers were stripped away and replaced with a unique key number that was subsequently used to link individuals in other databases.

**Ontario Health Insurance Plan (OHIP).** OHIP is a fee-for-service plan that captures the largest proportion of health care expenditures in the province of Ontario. At the time of data collection, roughly 94% of all medical doctors in Ontario had a fee-for-service practice. OHIP

records were coded to include: (a) the diagnosis issued by the health care professional providing the service; (b) the date the service was provided; and (c) the feecode which describes the service type. Using the feecode variable in the OHIP dataset, it was possible to code for two general locations where medical services were provided: those that occurred in an emergency room (ER), and those that took place elsewhere, the latter of which constituted "outpatient" encounters.

**Discharge Abstract Database (DAD) and Same Day Surgery (SDS)**. These data sources capture hospital inpatient admissions, or more accurately, "separations" from hospital in the province of Ontario. For these datasets, one record represents one separation from hospital which can last for one or more days for the DAD or less than a 24-hours for the SDS. Similar to the OHIP database, DAD and SDS records were coded to calculate the length of stay for each registered hospital visit, and disease codes based on the International Classification of Diseases (ICD) scheme, a globally recognized system by the WHO for coding and classifying diseases, symptoms, and health conditions.

**Ontario Mental Health Reporting System (OMHRS)**. This database captures hospital inpatient stays for which the most responsible diagnosis was specifically a mental health problem. (Prior to 2005, these hospitalizations were captured in the DAD.) Like the DAD and SDS records, OMHRS variables were coded to yield length of stay and ICD diagnostic codes for each hospitalization.

OHIP diagnosis codes were originally based on the ICD-9 classification system which was subsequently replaced by ICD-10 in 2002. Analysis of the frequency of OHIP encounters revealed that there were over 400 separate codes represented across more than 14K records in the dataset. Because the OHIP database contained the majority of cases for analysis, ICD-9 was used as the organizing framework to construct health outcome variables. To align diagnoses across datasets (OHIP, DAD, SDS, OMHRS), a coding system was was developed assign each code into one of seventeen broad disease categories (shown later in Table 3). Using ICD and OHIP codes, it was further possible to derive the following variables to examine service use for five specific mental health disorders: 1) substance use disorder (e.g., alcoholism; drug dependence); 2) psychotic disorder (e.g., schizophrenia, paranoid states); 3) personality disorders (e.g., borderline); 4) mood and anxiety (e.g., depression, anxiety); and 5) disorders of childhood & adolescence (e.g., conduct disorder, ODD, ADHD).

### *Creating a Uniform Follow-Up Interval and Case Exclusion*

Establishing a uniform follow-up interval for health outcomes was essential for several reasons. Most notably, boys were admitted to the SNAP-ORP program continuously from 1985 to 1999, meaning they were not the same age at the time of follow-up and, consequently, had varying levels of exposure to the healthcare system. Standardizing the follow-up period ensured that health service utilization was assessed during the same developmental stage for all participants. This was critical because the prevalence of diseases and the associated exposures to health risks were not assumed to be uniform across different ages. Age 12 was chosen as the start date for measuring health outcomes because preliminary analyses revealed that very few participants had full health system coverage from their discharge from the SNAP-ORP program to their 12th birthday. Similarly, a sensitivity analysis revealed that age 21 was the optimal cutoff that produced the largest sample of participants will full health coverage ($N$ = 247). To further ensure that study participants had an opportunity to register health events across the follow-up interval, three additional exclusionary criteria were applied: (1) participants had to be alive, (2) had at least one health system contact, and (3) resided in the province of Ontario between their 12th and 21st birthday. Applying these additional criteria resulted in a further reduction of the sample of 13 cases, resulting in a final sample of 234 cases for analysis (61.7% of the original sample of 379 boys).

### *Analytical Approach*

Chi-squared tests and logistic regression were used to test for differences for categorical variables (i.e., *prevalence* of disease, health encounters). Analyses of Variance (ANOVA) and OLS regressions were used for continuous variables (i.e., *frequency* of health encounters). Logarithmic transformations were applied to variables with skewed distributions to satisfy tests requiring assumptions of normality. Where appropriate, test statistics were calculated using log-transformed values, however, raw means and standard deviations are reported below for ease of interpretation.

EARL-20B total risk was operationalized as both categorical and continuous variables. For the former, the distribution of EARL total scores was split into thirds to yield three groups of roughly equal size denoting "low," "moderate," and "high" risk groups (Table 2). This approach was taken because trichotomisation has been previously shown to be a useful approach when comparing subgroups within distributions, especially in relation to logistic regression analyses (Farrington & Loeber, 2000; Stouthamer-Loeber et al., 1993). However, and in order to increase confidence that significant differences between categorical groups were not artefacts of cut-point selection, linear and logistic regressions were performed using continuous total EARL-20B scores to assess the robustness of between-group differences.

In cases where there was a significant association the EARL-20B total score and a specific health outcome variable, follow-up analyses were performed to assess whether specific EARL-20B items were significant independent predictors. To do so, each of the 20 EARL items was correlated with the relevant health outcome variable. Bivariate correlations with $P$-values of 0.10 or less were

subsequently entered into forward stepwise regressions. The decision to isolate a smaller number of independent predictors was made in order to minimize the potential negative influence of multicolinearity when fitting regression models (Tabichnick & Fidell, 2007). Models were configured with an entry P-value of .10 and removal P-value of .99. The latter was done in order to isolate significant independent predictors, and not build predictive models *per se*. This analytical approach for identifying important risk factors has been used previously with success (e.g., Farrington, Loeber, Jolliffe, & Pardini, 2008).

Analyses of disease prevalence and health service use for each of the ICD disease categories resulted in a large number of statistical tests which increased the possibility of Type I errors (rejecting the null hypothesis when it is true). Some researchers have argued in favor of applying the Bonferroni p-value correction to deal with this problem. However, this approach has attracted strong criticism for the possibility of increasing Type II errors (failing to reject the null hypothesis when it is false), thereby reducing statistical power (e.g., Feise, 2002, Nakagawa, 2004; Perneger, 1998). For this reason, and given the exploratory nature of the study, Bonferroni corrections were not applied. Instead, emphasis was placed on the magnitude of effect sizes: these included standardized parameter estimates (*Beta* or β) for linear regression, odds ratios (*OR*) for logistic regression, and product-moment correlation coefficients (*r*). For product-moment correlations, Cohen (1992) refers to values around .10 to be small, .30 to be medium, and .50 to be large effect sizes, respectively.

## Results

### *Health Service Use*

Looking at OHIP data, the 234 males in the sample accrued 14,101 health service encounters between the ages of 12 and 21. Most of these (93.3%) were encounters in outpatient settings; 6.7% represented encounters in an emergency room (ER). All boys had at least one outpatient visit and 80.8% had one or more ER visit. Based on SDS, DAD and OMHRS data, roughly one quarter of participants (25.2%) had at least one inpatient hospitalization. Using the EARL-20B total score as a measure of cumulative risk, chi-squared tests revealed no differences among EARL-20B risk groups in terms of the *prevalence* of ER visits or inpatient hospitalizations. These null findings were confirmed via logistic regression analyses that operationalized the EARL-20B total score as a continuous variable.

When examining the *frequency* of health service use, an ANOVA revealed that boys in the high-risk group had significantly more ER encounters compared to boys in the low-risk group, roughly 1.2 more, on average (see Table 3). The ANOVA result was statistically significant ($F(2,186) = 3.97$, $p < .05$). This finding was further supported by an ordinary least squares (OLS) regression, which treated the EARL-20B total score as a continuous predictor variable. The regression confirmed the association ($R^2 = .026$, $F(1,188) = 5.03$, $p = .026$) with a corresponding effect size ($r$) of .16. No significant differences were observed among EARL-20B risk groups for any of the other types of health services.

Were any individual EARL-20B risk factors associated with either the prevalence or frequency of ER use? For the *prevalence* of ER attendance, five EARL-20B items were included in a logistic regression model. As shown in Table 4, four emerged as significant independent predictors: (C4) having hyperactivity, impulsivity, or attention deficit problems; (C9) having police contact; (R2) being unresponsive to treatment; and somewhat counterintuitively, (C8) *engaging* in structured community activities (noting that C8 is scaled so that a lower score indicates more participation). Among these, item C4 was the strongest predictor ($OR = 3.55$, 95% CI: 1.82-6.91, $p < .001$) that increased odds of ER contact by more than threefold. Similarly, being unresponsive to treatment (R2, Child Responsivity) more than doubled the odds of accessing treatment in an ER. A possible explanation of the latter finding is that boys who were not receptive to interventions for their behavior problems may be similarly less likely to seek proactive medical care, instead relying on services only when their issues have escalated to a level requiring emergency attention.

For the *frequency* of ER attendance, correlations were calculated using log-transformed count variables for individuals who had attended an ER at least once ($N = 189$). The bivariate correlations and results of the regression model are presented in the right-hand column of Table 4. Of the seven EARL-20B items entered into the forward stepwise regression model, three emerged as significant independent predictors of ER frequency: (C2) early onset of behavioral difficulties, (C1) absence of developmental problems, and (C11) high levels of antisocial behavior. Among these, C2 was the strongest predictor, indicating that boys with an earlier onset of behavioral difficulties were more likely to accumulate more frequent ER encounters. One possible explanation for these findings is that, in the absence of community programs, parents brought their sons to the emergency room seeking treatment for their acute behavioural problems. The negative association with item C1 indicates that boys with early developmental problems were less likely to end up in the ER. This finding is consistent with studies suggesting that parents of children with developmental disabilities may be more reluctant to access ER services because the ER environment is often ill-equipped to adequately address their child's needs (e.g., Elliott et al., 2024).

### *Predicting Disease*

The next series of analyses examined the relationship between EARL-20B scores and the prevalence of disease based on ICD-9 categories. Dichotomous variables were created to capture whether individuals were *ever* treated for any of the health problems listed in Table 5 based on outpatient, emergency room, and inpatient service en-

counters. Analyses indicated that there were no significant differences among the three EARL-20B risk groups across disease categories with the exception of Category 5 (Mental and Behavioral Disorders): high-risk boys were significantly more likely to receive treatment for a mental or behavioral disorder compared to low-risk boys. This was supported by a three-group chi-square test ($\chi^2(2) = 9.42$, $p = .009$) and a logistic regression model treating the EARL-20B total score as a continuous variable (*OR* = 1.07, 95% CI: 1.01–1.13, *B* = .066, *SE(B)* = .028, $\chi^2(1) = 5.57$, $p = .018$).

Analyses focusing on the relationship between the EARL-20B total score and the *frequency* of health service included the first 16 disease categories with sufficient cases to permit statistical analysis for outpatient and ER encounters (see Note, Table 5; inpatient admissions were excluded due to small numbers). There were no differences among risk groups for the 11 disease categories tested for outpatient care. Across the five comparisons involving ER encounters, a significant difference emerged among the risk groups specifically for Category 16 (injuries, poisonings, and external causes of morbidity). An ANOVA showed that high-risk boys (*M* = 2.73, *SD* = 3.50) had more ER encounters than moderate-risk (*M* = 2.12, *SD* = 2.42) and low-risk boys (*M* = 1.77, *SD* = 2.10); ($F(2,163) = 3.61$, $p = .029$). This finding was supported by linear regression analysis (*B* = .007, *SE(B)* = .003, $t = 2.44$, $p = .016$).

To identify significant independent predictors of accidents and injuries, individual EARL items were correlated with the dichotomous injury variable, resulting in three significant correlates (F2, C3, C8). Logistic regression modeling revealed that two of these EARL-20B items measuring abuse, neglect, and trauma (C3), and participation in structured community activities (C8) were significant independent predictors, with associated odds ratios of 1.95 (95% *CI*: 1.10-3.44) and 0.33 (95% *CI*: 0.16-0.66), respectively ($\chi^2(2) = 17.52$, $p < 0.001$).

***Mental Health Outcomes***

Based on all outpatient, ER, and inpatient encounter data, it was possible to use ICD and OHIP codes to drill down into the "Mental and Behavioural Disorders" category and generate five discrete, dichotomous mental health disorder variables: 1) substance use disorder; 2) psychotic disorder; 3) personality disorder; 4) mood and anxiety disorder; and 5) disorders of childhood and adolescence. Each of these variables was subsequently compared with EARL-20B total scores to determine whether high risk boys were more likely to be treated for these conditions.

Table 6 shows that there were no differences among risk groups for the prevalence of substance use disorders (at about 18%), personality disorders (at about 16%) or psychotic disorders (at about 7%). However, higher EARL-20B risk scores were associated with a higher prevalence of health service use for mood and anxiety disorders, or disorders of childhood and adolescence. As Table 6 shows, these differences were statistically significant for tests based on both categorical and continuous predictor variables.

The next series of analyses focussed on *whether* individual EARL items were associated with these conditions. Initial analyses focusing on mood and anxiety problems revealed that five of EARL-20B items were significantly correlated (i.e., F2, C3, C11, C12, R2). For the logistic regression, only the EARL-20B item measuring abuse, neglect, and trauma (C3) remained a significant predictor, with a corresponding odds ratio of 1.62 (95% CI: 1.18–2.25, $\chi^2(1) = 9.09$, $p < 0.01$). This indicates that experiencing abuse, neglect, or trauma before age 12 was associated with a 62% higher likelihood of receiving treatment for a mood/anxiety disorder between ages 12 and 21.

Disorders of childhood and adolescence are defined in the DSM-IV to include a broad spectrum of problems, for example, but not limited to: learning and communication disorders, developmental disorders, conduct disorder, oppositional defiant disorder, attention-deficit and hyperactivity disorder, and eating disorders of early childhood (American Psychiatric Association, 2022). When Pearson correlations were calculated for each of the EARL-20B risk items, 10 met the criterion for inclusion in the logistic regression model (C2, C3, C4, C6, C7, C9, C10, C11, C12, and R2). Of these, only two remained significant independent predictors: having hyperactivity, impulsivity, or attention deficit problems (C4; OR = 2.09, 95% CI = 1.39–3.15, $p < .001$) or having antisocial peers (C6; OR = 1.87, 95% CI = 1.24–2.83, $p < .01$). The resulting model was highly significant ($\chi^2(2) = 25.95$, $p < .001$). The significant association with C4 might be indicative of the continuity of hyperactivity, impulsivity, and attention deficit symptoms from childhood into adolescence and early adulthood. Additionally, associating with antisocial peers (C6) in childhood increased the odds of being treated for one or more disorders of childhood and adolescence by 87%. Due to the nature of the OHIP data, however, it was not possible to disaggregate outcome variables to examine whether specific childhood diagnoses within each category were more strongly associated with items C4 or C6.

## Discussion

The analyses presented in this paper provide new insights into the relationship between EARL-20B total and individual item risk scores and public health service use. It was shown that a multidimensional risk assessment tool, originally created to predict future antisocial behaviour in young boys, can also be used to forecast a range of health service use, disease, and mental health conditions in adolescence and early adulthood. One of the main findings of the study was that the total EARL-20B score was a significant predictor of frequency of ER use, indicating that children at higher risk for future antisocial behaviour ac-

cessed emergency medical care for acute health problems, most often stemming from accidents and injuries requiring immediate medical attention. Looking at individual EARL item predictors, there were some interesting differences between items that predicted prevalence and frequency of ER use. For prevalence, being hyperactive, impulsive or having attendtion deficits (C4), having police contact (C9), engaging in community activities (C8) and not being amenable to treatment (R2) predicted *whether* boys accessed emergency care. Once there, the level (C11) and onset (C2) of their behaviour problems and a lack of developmental deficits (C1) contributed to the frequency of ER attendance.

As reviewed earlier, the associations between impulse-control problems, childhood behaviour disorders and accidents and injury are well-documented in the literature (e.g., Brehaut et al., 2003; Davidson, 1987) and these were replicated in the current study. Item C4 was the strongest predictor (*OR* = 3.55) which can be interpreted as boys who were positively identified as having one or more of these problems (i.e., scored 2) were more than 12 times as likely (i.e., 3.55 X 3.55 = 12.60) to attend an emergency room compared to boys without these problems (i.e., scored 0). Impulsive people tend not to think before they act and, as such, may take more risks increasing their odds of injury. This line of reasoning is consistent with prior research (e.g., Bruce et al., 2007). Importantly, the large effect size underscores the need to account for disruptive attention and behavioral regulation traits when developing treatment plans for children with conduct problems.

The strong negative association (OR = .32) between structured community activities (C8) and ER use was unexpected. Although conceptualized as a protective factor to mitigate participation in crime, the odds of ending up in an emergency room increased nearly tenforld (1/.32 X 1/.32 = 9.76) for those who engaged in such activities (i.e., scored 0) compared to those who did not (i.e., scored 2). One explanation for this finding is that the sport and recreational programs that the boys participated in provided additional opportunities to become injured. In addition to individual factors such as impulsivity and risk taking (i.e., captured under item C4), Schwebel (2006) highlights additional contextual factors that may play a role in sustaining injuries such as the availabilty of peers modeling of risk-taking behaviors, or a lack of adequate adult supervision. The key takeaway from this finding is that while participation in community-based leisure programs may provide a protective function for criminal outcomes, it may impose increased health risks. Clinicians working with antisocial children should be mindful of this when recommending or encouraging involvement in such activities.

Logistic regression analysis also showed that experiencing abuse, neglect, or trauma (C3) in childhood increased the odds of sustaining injuries between the ages of 12 and 21 by a factor of 3.8 (i.e., 1.95 × 1.95). This might reflect a continuity of abuse from middle childhood into adolescence and early adulthood (e.g., injuries sustained at the hands of caregivers) -- events that may increased the need to access healthcare. It is also possible, consistent with explanations provided by Schwebel (2006), that the absense of supervision or profound neglect may have created an environment where kids were able to engage in more risk-taking activities resulting in serious injury.

Analysis of overall health service use by ICD-9 categories revealed only one significant difference among EARL-20B risk groups: higher EARL-20B total scores were associated with a higher prevalence of mental or behavioural disorders. An examination of specific mental health diagnoses showed that total EARL-20B scores predicted a higher prevalence of illness for two of the five disorder categories tested: mood and anxiety disorders, and disorders of childhood and adolescence. No significant relationships were found between the total score and personality, psychotic and substance use disorders. These latter null findings are not surprising since their onset and diagnosis typically occurs later in adolescence and adulthood. Still, it was hypothesized that there would be a significant association between the total EARL score and substance use disorders given prior research (Brook & Cohen, 1992; Dobkin, Tremblay, & Masse, 1995; Sourander et al., 2005). For substance use disorders specifically, the lack of a positive association might also be explained by the fact that most of the health encounters measured in the current study took place within a general physician context which, in comparison to specialized addictions or concurrent diagnosis programs, may be less equipped to reliably diagnose such problems (Bennett, Bellack, & Gearon, 2006).

It is not surprising that the single EARL-20B item measuring early childhood abuse, neglect and trauma (C3) was associated with health care related to mood and anxiety problems. There is abundant research that demonstrates that maltreated children are more likely to experience subsequent internalizing problems (e.g., Afifi et al., 2008; Kalmakis et al., 2015; Kaplow & Widom, 2007). Using individual EARL-20B items to predict the prevalence of disorders of childhood and adolescence identified two significant predictors: peer socialization (C6) and hyperactivity, impulsivity, and attention deficits (C4). The significant association with C6 may reflect the well-established link between conduct disorder and antisocial peers (e.g., Gallupe et al., 2019). Unfortunately, as noted earlier, the data could not be disaggregated into specific diagnoses to test the association with conduct disorder directly. In contrast, the association with C4 would be anticipated because the diagnostic category aligns with the same disorders assessed under item C4. This interpretation is further supported by epidemiological research showing that ADHD is typically diagnosed in childhood and often persists into adolescence and adulthood (Barbaresi et al., 2013; Visser et al., 2014).

Taken together, this study adds to the expanding body of research examining the relationship between early

childhood conduct problems and health problems later in life. The study had several strengths which included the use of a multi-dimensional index of risk which allowed the simultaneous consideration of a wide range of risk factors (Schwebel & Gaines, 2007). Second, health outcomes were measured using official administrative databases which had the advantage of increasing external validity and minimizing participant bias associated with self-reported measures. Third, the follow-up period spanning nine years allowed for a robust test of the EARL-20B's predictive power during adolescence and early adulthood. Lastly, the consideration of all ICD disease categories in the analysis provided a more exploratory view of health data, avoiding the limitation of shortlisting specific diseases, as observed in prior studies (e.g., Odgers et al., 2007).

With these strengths in mind, several limitations warrant consideration. Chief among them is the lack of clarity regarding the causal relationships between predictor and outcome variables. To qualify as a true risk factor, a variable must temporally precede the outcome it is believed to influence (Kraemer et al., 1997). For this reason, researchers distinguish between "risk factors" as causal agents and "risk markers" that may more accurately represent a correlational relationship between variables (Mulvey, 2005). Although each of the risk factors in the EARL-20B was scored prior to the measurement of the health outcome variables, it is not known whether they were mediated by developmental processes or other intervening, unmeasured factors. For example, it was possible that study boys had underlying health problems that preceded the onset of risk factors that were measured during their involvement in the SNAP-ORP program. Such a limitation could be addressed by furture research that includes historical health service use as a control variable in prediction models. Second, reliance on official records for measuring health outcomes limited the data to services within the public system, excluding private care or other forms of treatment. Finally, the absence of a non-antisocial comparison group prevented an examination of whether the prevalence of health outcomes in this study differ from those in the general population. Future studies could address this limitation by including a normative control group.

### *From Crime Prevention to Health Promotion*

Two decades ago, Tolan and Dodge (2005) made a compelling argument for recognizing antisocial behavior as a legitimate healthcare concern. More than a decade later, Burt and colleagues (2018) recharacterized this concern as a crisis, advocating for swift reorganization and reallocation and resources to address the significant individual, familial, and societal burdens associated with conduct disorder. The findings from this study are consistent with this call to action and provide the impetus for greater investments in children's mental health, pediatric health care, and injury prevention initiatives aimed at antisocial children. As the leading cause of death in children, accidents and injuries are important to prevent in their own right. For at-risk children, however, it is important to recognize that they can compound other risk factors for antisocial behaviour, for example, causing school absences that hinder academic achievement (Boyce, King, & Roche, 2008). It must also be stressed that the negative outcomes of conduct disorder extend beyond physical health problems to include mental illness later in life. This study showed that boys who experienced trauma, abuse or neglect were more likely to access care for a mood and anxiety disorder. Considering that many of these abused kids will end up in child welfare systems that are typically unprepared to meet their needs (Herz, Harada, Lecklitner, Rausao, & Ryan, 2009), it becomes clear that a systems-wide approach (see Kazak et al., 2010) is needed not only steer them away from a life of crime, but also to promote their overall health and well-being.

## Conclusions

If a common societal goal is to "save children from a life of crime," why would we not also want to save these same children from a life of disease, mental illness, and the long list of other negative life events that are implicated with an antisocial lifestyle? Historically, the EARL-20B has been used by clinicians working with children to assess their "antisocial potential" – the central construct in David Farrington's Integrated Cognitive Antisocial Potential (ICAP) theory of crime (Farrington, 2008) that inspired the development of the EARL-20B. Study findings provide strong empirical support for expanding the community of EARL-20B users to include professionals specializing in injury prevention and health promotion. This presents a promising opportunity for multi-sectoral collaboration to redefine crime prevention policy, prioritizing positive health and mental health outcomes as essential measures of success for antisocial children and their families. While there is still much work to be done, this study provides some direction of how research, practice and policy can move forward in pursuit of this goal.

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**Table 1**
**Items in the Early Assessment Risk List Items for Boys (EARL-20B)**

| Item/domain/Label | | Representative content |
|---|---|---|
| **FAMILY** | | |
| F1 | Household circumstances | Poor living conditions, poverty, financial hardship |
| F2 | Caregiver continuity | Unstable caregiver relationships, out of home placements |
| F3 | Family supports | Lack of positive familial supports, family isolation |
| F4 | Family stressors | Marital conflict, mental illness in the family, job loss |
| F5 | Parenting style | Lack of supervision, harsh or overly permissive parenting |
| F6 | Family antisocial values and conduct | Caregiver or sibling criminality, antisocial values |
| **CHILD** | | |
| C1 | Developmental problems | Fetal alcohol syndrome, learning disabilities |
| C2 | Onset of behavioral difficulties | Behavioral problems starting at an early age |
| C3 | Abuse/neglect/trauma | Physical, sexual, emotional abuse or neglect |
| C4 | Hyperactivity/impulsivity/attention deficits (HIA) | Symptoms or diagnosis of ADHD, and/or impulsivity |
| C5 | Likeability | Unattractive physical appearance, poor social skills |
| C6 | Peer socialization | Age-inappropriate friends, deviant peers, social exclusion |
| C7 | Academic performance | Markedly behind grade level in core subjects |
| C8 | Structured community activities | Not engaged in organized community activities |
| C9 | Police contact | Previous contact with police or other authority figures |
| C10 | Antisocial attitudes | Attitudes in favor of rule breaking, lack of empathy |
| C11 | Antisocial behavior | Severe, frequent, or pervasive rule-breaking behaviour |
| C12 | Coping ability | Inability to cope, anxiety, depression or withdrawal |
| **RESPONSIVITY** | | |
| R1 | Family responsivity | Parental denial of a problem, lack of engagement |
| R2 | Child responsivity | Uncooperative child, unwillingness to engage in treatment |

Note: ADHD = attention deficit hyperactivity disorder.

**Table 2**
**EARL-20B Risk Groups**

| Total Score Statistic | EARL-20B Risk Group | | | |
|---|---|---|---|---|
| | Low | Moderate | High | TOTAL |
| *Range* | 0-17 | 18-23 | 24-40 | 0-40 |
| *Mean* | 14.12 | 20.44 | 27.43 | 20.98 |
| *(SD)* | *(2.92)* | *(1.67)* | *(3.18)* | *(6.15)* |
| *N* | 75 | 73 | 86 | 234 |

**Table 3**
**The Relationship between the EARL 20B Total Score and Health Service Frequency by Type**

| SERVICE TYPE/VARIABLE | *N* | EARL-20B Risk Group | | | | | | ANOVA | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low | | Moderate | | High | | | |
| | | *mean* | (*SD*) | *mean* | (*SD*) | *mean* | (*SD*) | *F*-value | *df* |
| **Emergency Room (OHIP)** | **189** | **[a]3.85** | **(2.97)** | **5.45** | **(5.01)** | **[a]5.66** | **(4.86)** | ***3.97** | **2,186** |
| Outpatient (OHIP) | 234 | 50.60 | (50.51) | 54.00 | (44.30) | 62.95 | (66.92) | 1.10 | 2,231 |
| Total OHIP | 234 | 88.38 | (73.43) | 94.23 | (92.27) | 100.69 | (85.28) | 0.53 | 2,231 |
| Inpatient Admissions | 59 | 1.52 | (1.21) | 1.50 | (0.78) | 1.59 | (0.85) | 0.14 | 2,56 |
| Length of Inpatient Stay (days) | 59 | 5.31 | (5.66) | 5.55 | (6.58) | 6.36 | (12.87) | 0.06 | 2,56 |

**NOTES: **P*<.05. Tests were performed on log-transformed values; raw means and standard deviations are shown in the table. Superscripts denote statistically significant groups based on post-hoc (Scheffé) tests; OHIP = Ontario Health Insurance Plan.**

**Table 4**
**EARL-20B Item Predictors of Prevalence and Frequency of ER Encounters**

| EARL-20B ITEM | | | Prevalence | Frequency |
|---|---|---|---|---|
| F1. | Household Circumstances | | -.024 | .041 |
| F2. | Caregiver Continuity | | .008 | .111 |
| F3. | Supports | | -.117† | -.019 |
| F4. | Stressors | | -.012 | .023 |
| F5. | Parenting Style | | -.011 | -.027 |
| F6. | Antisocial Values & Conduct | | .031 | .110 |
| C1. | Developmental Problems | | .013 | -.130† |
| C2. | Onset of Behavioural Difficulties | | .075 | .168* |
| C3. | Abuse/Neglect/Trauma | | .095 | .076 |
| C4. | Hyperactivity/impulsivity/attention deficits (HIA) | | .267* | .176* |
| C5. | Likeability | | -.005 | -.011 |
| C6. | Peer Socialization | | .041 | .111 |
| C7. | Academic Performance | | .025 | .068 |
| C8. | Structured Community Activities | | -.240* | .042 |
| C9. | Police Contact | | .118† | .161* |
| C10. | Antisocial Attitudes | | .060 | .132† |
| C11. | Antisocial Behaviour | | .108 | .188* |
| C12. | Coping Ability | | .050 | .066 |
| R1. | Family Responsivity | | -.060 | .021 |
| R2. | Child Responsivity | | .191* | .144* |
| Model | | number of individuals | 234 | 189 |
| | | # items entered | 5 | 7 |
| | | SIGNIFICANT PREDICTORS<br>Prevalence: (odds ratio, 95% CI)<br>Frequency: (parameter estimate *Beta* ) | ***C4 (3.55, 1.82-6.91)<br>***C8 (0.32, 0.19-0.55)<br>*R2 (2.28, 1.20-4.33)<br>*C9 (1.57, 1.01-2.46) | **C2 (+.109)<br>*C11 (+.105)<br>*C1 (-.085) |
| | | Model | $\chi^2$[4] = 47.32*** | *F*[3,185] = 5.90*** |

*****P < .001; **P<.01; *P<.05; †P<.10 (two-tailed).**

**Table 5**
**The Prevalence of Disease by ICD-9 and Categorical Risk Group (column %)**

| ICD 9 Disease Categories | EARL-20B RISK GROUP | | | |
|---|---|---|---|---|
| | Low (N=75) | Mod (N=73) | High (N=86) | TOTAL (N=234) |
| 1. Infectious and parasitic diseases (a) | 85.3 | 84.9 | 81.4 | 83.7 |
| 2. Neoplasms | 10.7 | 8.2 | 10.5 | 9.8 |
| 3. Endocrine, nutritional, metabolic, immunity (a) | 17.3 | 23.9 | 18.6 | 19.7 |
| 4. Blood and blood forming organs | 6.7 | 15.1 | 11.6 | 11.1 |
| 5. Mental and behavioral disorders (a, b) | **69.3** | **82.1** | **88.4** | 80.3 |
| 6. Nervous system, eye, adnexa, ear, mastoid (a) | 72.0 | 64.4 | 74.4 | 70.5 |
| 7. Circulatory system (a) | 37.3 | 53.4 | 44.2 | 44.8 |
| 8. Respiratory system (a, b) | 90.7 | 94.5 | 97.7 | 94.4 |
| 9. Digestive system (a, b) | 61.3 | 64.4 | 55.8 | 60.3 |
| 10. Genitourinary system (a) | 26.7 | 26.0 | 44.2 | 32.9 |
| 11. Pregnancy, childbirth and the puerperium | | | | |
| 12. Skin and subcutaneous tissue (a) | 77.3 | 76.7 | 81.4 | 78.6 |
| 13. Musculoskeletal system and connective tissue (a, b) | 73.3 | 64.4 | 70.9 | 69.7 |
| 14. Congenital, deformations, abnormalities | 9.3 | 2.7 | 3.5 | 5.1 |
| 15. Certain conditions in the perinatal period | | | | |
| 16. Injury, poisoning, accidents, diseases of external origin (a, b) | 89.3 | 93.2 | 89.5 | 90.6 |
| 17. Ill defined conditions | 74.7 | 72.6 | 79.1 | 75.6 |
| 18. Missing diagnosis | 20.0 | 19.2 | 29.1 | 23.1 |

Notes: Disease categories with sufficient cases to test the statistical relationship between EARL-20B risk and frequency are noted for outpatient (a) and ER (b) service use; bolded numbers denote statistically significant between-group differences.

**Table 6**
**Prevalence of Mental Diagnoses by EARL-20B Risk Status (*N*=234)**

| Mental Health Disorder/Diagnosis | EARL-20B RISK GROUP | | | | Continuous EARL 20B | | | |
|---|---|---|---|---|---|---|---|---|
| | Low (N=75) | Mod (N=73) | High (N=86) | $\chi^2$[2] | B | SE(B) | $\chi^2$[1] | SE |
| Substance Use | 16.0% | 16.4% | 22.1% | 1.26 | .030 | .027 | 1.86 | .052 |
| Psychotic | 6.7% | 6.8% | 6.9% | 0.01 | .006 | .042 | 0.02 | .079 |
| Personality | 18.7% | 15.1% | 15.1% | 0.48 | .002 | .028 | 0.01 | .054 |
| Mood/Anxiety | 53.3% | 68.5% | 75.6% | 9.11* | .063 | .024 | 7.05** | .039 |
| Childhood & Adolescence | 34.7% | 46.6% | 60.5% | 10.76** | .067 | .023 | 8.96** | .036 |

NOTES: ***P < .001; **P<.01; *P<.05.