

**Risk Factors for Conduct Disorder among Canadian Children:
A Focus on Childhood-Onset Conduct Disorder**

by

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Abstract

Childhood-onset Conduct Disorder (CD) is a serious mental health issue. Research has shown that when CD affects a child under 10, the problems are more likely to persist as the child grows up. Research has also shown that there are many risk factors associated with CD. However, there have been no known studies conducted for Canada looking exclusively at risk factors for childhood-onset CD. This thesis quantitatively assesses the impact of risk factors identified in the Canadian *National Longitudinal Survey of Children and Youth* (NLSCY): Cycles 1 & 3 on childhood-onset CD using binary response regressions. This research concluded that major risk factors associated with childhood-onset CD in Canada include: being a male, comorbidity with ADHD, low income, low parental education, *maternal* depression, family dysfunction, hostile/ineffective parenting, yelling at a child often, exposure to violence in home, parental smoking, and mother being very young at the birth of the child.

Dedication

To my dear husband, Silas, for his unending support, level-headedness and love. Thank you for inspiring me to always do the best I can. I give my deepest expression of love and appreciation for the encouragement you gave me during this graduate program.

To my wonderful parents, Ruth & Prem, for their unconditional love and support. I could never have done this without their faith, support and constant encouragement. Thank you for all the sacrifices you have made and for teaching me life's important lessons.

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Table of Contents

Abstract	ii
Dedication	iii
Acknowledgements	iv
Introduction	1
Purpose of the study	1
Research Questions	4
Hypothesis	5
Thesis Overview	7
Literature Review	8
Developmental Pathways to CD: A Focus on Childhood-onset Pathway	8
Consequences of Childhood-onset CD	10
Prevalence of Conduct Disorder	14
Risk Factors for Childhood-Onset Conduct Disorder	16
Methodology	25
Gaining Access to the NLSCY	25
The National Longitudinal Survey of Children and Youth: Cycle 1 & 3 (1994-95, 1998-9)	26
Weights	27
Missing Values	27
Defining Dependent variable: Childhood-onset CD	28

Independent Variables Created or Utilized.....	31
Research Methods.....	38
Descriptive analysis	38
Binary response regression analysis	39
Results.....	41
Prevalence of Childhood-onset CD	41
Descriptive Statistics: Dichotomous Variables.....	44
Descriptive Statistics: Continuous Variables.....	47
Binary Response Regression.....	49
Regression Results	56
Discussion and Conclusion.....	62
Individual and Family risk factors	62
Prevalence of childhood-onset CD	70
Prevalence of childhood-onset CD: Age.....	71
Prevalence of childhood-onset CD: Provinces	71
Prevalence of childhood-onset CD: Symptoms	72
Summary & Recommendations	74
Limitations & future research	76
References.....	78
Appendix.....	98
Curriculum Vitae or <i>CV</i>	

List of Tables

Table 1 DSM-5 Conduct Disorder Symptoms	9
Table 2 Summary of the Major Risk Factors Associated with Conduct Disorder	15
Table 3 NLSCY Cycle 1 &3 Comparable DSM-V Symptoms	29
Table 4 Independent Variables	38
Table 5 Prevalence of Childhood-onset CD by Age (4-10 years): Cycle 1	42
Table 6 Prevalence of Childhood-onset CD by Province (4-10 years): Cycle 1	42
Table 7 Childhood-onset CD by number of symptoms (4-10 years): Cycle 1	43
Table 8 Top Five Childhood-onset CD symptoms in Canada (4-10 years): Cycle 1	43
Table 9 Mean and Standard Deviation of Dichotomous Variables (4-10 years): Cycle 1	45
Table 10 Mean and Standard Deviation of Continuous Variables (4-10 years): Cycle 1	48
Table 11 Linear Probability Model for Childhood-onset CD (4-10 years): Cycle 1	50
Table 12 Odds Ratio for Childhood-onset CD (4-10 years): Cycle 1	53

List of Abbreviations

ADHD	Attention-Deficit Hyperactivity Disorder
APA	American Psychiatric Association
ASPD	Antisocial Personality Disorder
CCJS	Canadian Centre for Justice Statistics
CD	Conduct Disorder
CMHO	Children's Mental Health Ontario
DSM-IV	The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition
DSM-5	The Diagnostic and Statistical Manual of Mental Disorders, 5 th Edition
ETS	Environmental Tobacco Smoke
HRDC	Human Resources Development Canada
ICD	International Classification of Diseases
ICEC	INSERM Collective Expertise Centre
MFIP	Minnesota Family Investment Program
NLSCY	National Longitudinal Survey of Children and Youth
PMK	Person Most Knowledgeable
RDC	Research Data Center
STATA	Statistics and Data (Software)
UNB	University of New Brunswick
WHO	World Health Organization

Introduction

Purpose of the study

“If environmental risk factors for [mental illness] can be validated and confirmed, there is every reason to expect they will point to preventive measures that lower their risks and morbidity.”

–Alan Brown, Columbia University Medical Center in Schmidt (2007, p. 405).

Conduct Disorder (CD) in children is a psychiatric syndrome that begins in childhood or adolescence, and is characterized by a persistent and repetitive pattern of serious rule-breaking and violation of the rights of other people. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria distinguish between childhood-onset and adolescent-onset CD. The DSM-5 states that childhood-onset type of CD occurs when “Individuals show at least one symptom characteristic of conduct disorder prior to age 10 years” (American Psychiatric Association [APA], 2013).

The term “environment” in the realm of mental illness is defined broadly, some going so far as to suggest that it encompasses everything that is not an inherited gene (Schmidt, 2007). Conduct problems during childhood are associated with multiple risk factors (Odgers, Caspi, Broadbent & Dickson, 2007). This thesis quantitatively explores the relationship between multiple risk factors (individual and family factors) and childhood-onset CD in Canadian children aged 4 to 10, using the *National Longitudinal Survey of Children and Youth* (NLSCY) dataset. In addition, this study also estimates the prevalence of childhood-onset CD in Canada based on the DSM-5 cut-off.

This chapter introduces the issue of childhood-onset CD and the NLSCY data set, poses the research questions to be answered, and presents an overview of the thesis.

Childhood-onset CD

In the last three decades, developmental psychopathology framework has emerged as a key perspective with the synthesis of biological, developmental and psychological views on CD (Pardini & Frick, 2013). The success of developmental psychopathology had a major impact on the explanations and classification of CD. In 1965, the eighth version of International Classification of Diseases (ICD), contained some categories, referring specifically to disorders of conduct. In the US, DSM-II was the first version of DSM to mention CD in 1968 (Norberg, 2010). In 1992, ICD-10 classified CD in alignment with the DSM. In 1994 the distinction between childhood-onset and adolescent-onset forms of CD was set out in the DSM-IV. Since childhood-onset CD symptoms have been consistently associated with a persistent form of antisocial behavior, the childhood-onset subtype was retained in DSM-5 (Pardini & Frick, 2013).

Research has revealed that there are at least three different pathways through which children may develop CD: 1. the developmental timing of CD onset; 2. the presence of callous-unemotional (CU) traits; and 3. the presence of severe anger dysregulation. This study is focusing on the first pathway, the developmental timing of CD onset. This pathway includes two subtypes: childhood-onset CD type (occurrence of at least one symptom prior to age 10 years) and adolescent-onset type (absence of any symptom prior to age 10) (Drabick, Steinberg & Hampton, 2016). This study is focusing on the childhood-onset CD.

Both retrospective and prospective studies have shown that most adulthood mental disorders begin in childhood and adolescence (Merikangas et al., 2009). Some cases of CD begin in early childhood, often by the preschool years (Mental Health Canada, n.e.). It is reported that CD has a significant impact on the quality of life of children and their caregivers. Rates of other mental health problems including Antisocial Personality Disorder (ASPD) increase considerably for adults who had CD in childhood (National Academies of Sciences, Engineering, and Medicine [NASEM], 2015). Thus, the extent and impact of CD is broad and a child's aggressive behavior and destructive deeds have the potential to directly and indirectly affect numerous people in the child's life (Roberts, Smith & Nason, 2001).

This study is important, as it will try to understand the risk factors for childhood-onset CD in Canada. In 2012, after a Canadian study on risk factors associated with CD in early adolescence (ages 12-13), Public Safety of Canada recommended more research in this field and stated "given that knowledge on identifying conduct disorder categories and their associated risk factors is still relatively new in Canada, future research should attempt to replicate and extend the present findings using samples of children and adolescents." (2012, para. 6).

Identifying Childhood-onset CD

The DSM definition is useful for medical professionals in establishing a diagnosis of childhood-onset CD. In a child, younger than 10 years, the repetitive presence of only 1 of the 15 symptoms listed in the DSM-IV or DSM-5 is sufficient for diagnosis of

childhood-onset CD (Bernstein, 2016). In this study of Canadian children under the age of 10 years, the DSM-5 acts as a foundation for the quantitative analysis of the secondary data provided by Statistics Canada.

The National Longitudinal Survey of Children and Youth (NLSCY)

The *National Longitudinal Survey of Children and Youth* (NLSCY) is a long-term study of Canadian children that follows their development and well-being from birth to early adulthood (Statistics Canada, 2010). The NLSCY is designed to collect information about factors influencing a child's social, emotional and behavioral development and to monitor the impact of these factors on the child's development over time. The collection for the first cycle of the NLSCY began in 1994 with one large cohort of new borns- to 11-year-olds who lived in any province. In Cycle 8, they were 14 to 25 years old. From Cycle 2 onwards the NLSCY consists of both a longitudinal and a cross-sectional sample.

The availability of data from the NLSCY dataset presents the health researchers with a unique opportunity for a cross-sectional as well as longitudinal analysis of the problem of childhood-onset CD in Canada. The first three Cycles of the NLSCY specifically include certain questions related to CD symptoms under the DSM criteria for the desired age group for this thesis —children under 10 years old. In the latter cycles in the NLSCY, children in the sample are either in their adolescence or adulthood and do not fit the criteria for childhood-onset CD.

Research Questions

This research questions addressed in this thesis are:

1. What risk factors are associated with childhood-onset CD in Canada?

2. What is the prevalence of childhood-onset CD among Canadian children?
3. Is childhood-onset CD more prevalent among boys than girls and do boys generally display more risk factors early in their development?
4. Do children from low-income households have greater likelihood of developing childhood-onset CD?
5. What is the prevalence rate of comorbid ADHD with CD in children under 10 years of age in Canada?

The results of this thesis will contribute to a better understanding of childhood-onset CD among Canadian children.

Hypothesis

In 1993, Terrie Moffitt proposed a dual taxonomy for CD based around the time of onset ('childhood-onset' versus 'adolescent-onset' CD). Moffitt (1993) made specific predictions about which risk and protective factors should be related to childhood-onset CD (early-onset CD). Moffitt hypothesized that individual and family characteristics (e.g., gender, hyperactivity, child rearing practices and parental deviance) should be associated with childhood-onset CD (McCabe, Hough, Wood, & Yeh, 2001).

This study proposes to examine the following hypothesis generated by Moffitt's theory in a large nationally representative sample of Canadian children, the NLSCY, who meet the criteria for childhood-onset CD. Specifically, we will test if individual and family risk factors such as being a male, comorbidity with ADHD, low family income, low parental education, maternal depression, negative/ineffective parenting, physical punishment, yelling at a child often, family dysfunction, single-parent households,

mother being very young at the birth of the child; conflict between parents, parental smoking, and exposure to violence are associated with childhood-onset CD. Based on the literature and information contained in the NLSCY, the following risk factors were examined in this thesis:

Sociodemographic Factors

- Age of the child
- Gender of the child
- Ethnicity of the child
- Province of residence
- Place of residence (urban/rural)
- Family income (low income)
- Single parent households
- Mother's age at the birth of the child
- Parental education (less than high school)

Family Characteristics

- Parental smoking
- Parental alcohol use
- Dysfunctional family

Child Experiences

- Maternal depression
- Negative/ineffective parenting

- Exposure to violence in home
- Conflict between parents

Using the statistical software STATA, this thesis applies binary response regression to explore the relationship between childhood-onset CD and the factors listed above and to answer the research questions posed.

Thesis Overview

Chapter Two covers literature review. Many of the studies included in the study deal with consequences of childhood-onset CD and risk factors for childhood-onset CD. The thesis focuses on research results relevant to the current study.

Chapter Three describes the methodology used in this research. The NLSCY dataset does not have a childhood-onset CD variable, thus a binary response variable was created in STATA as our dependent variable from the NLSCY survey questions that closely match the DSM-5 CD symptoms. After defining the dependent variable, a list of independent variables that reflect the risk factors are used in regression.

Chapter Four details the results of the analysis. The childhood-onset CD variable, which is a binary variable, is regressed against various independent variables given in Chapter Three. From these, the major risk factors emerge that correlate with childhood-onset CD in Canada. A detailed discussion of the results follows, with a reference to research results in the literature.

Chapter Five provides a discussion of the study, and presents the conclusions and policy recommendations.

Literature Review

Developmental Pathways to CD: A Focus on Childhood-onset Pathway

Conduct Disorder (CD) refers to a form of childhood psychopathology involving a repetitive and persistent pattern of behavior in which the basic rights of others (e.g., aggression to people and animals, destruction of property, deceitfulness or theft) or major age-appropriate societal norms or rules (e.g., staying out at night despite parental prohibitions, running away from home, truant from school) are violated (APA, 2013). The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) lists CD as being part of the class of disorders labeled as “Disruptive, Impulse Control, and Conduct Disorders,” which all involve problems in the self-control of emotions and behaviors (APA, 2013).

The CD subtyping based on time of onset has achieved widespread acceptance in defining meaningful subgroups of children with CD (childhood-onset CD type and adolescent-onset type) who differ on the causal processes that lead to the child’s aggressive and antisocial behavior (Frick, 2004). The DSM-5 defines childhood-onset type of CD occurs when “Individuals show at least one symptom characteristic of conduct disorder prior to age 10 years” (APA, 2013) (Table 1). Adolescent-onset type of CD in DSM-5 is defined as individuals showing no symptom characteristic of CD prior to age 10 years (APA, 2013).

Table 1 DSM-5 Conduct Disorder Symptoms

<p>Aggression to people and animals</p> <ol style="list-style-type: none"> 1. often bullies, threatens, or intimidates others 2. often initiates physical fights 3. has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun) 4. has been physically cruel to people 5. has been physically cruel to animals 6. has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery) 7. has forced someone into sexual activity
<p>Destruction of property</p> <ol style="list-style-type: none"> 8. has deliberately engaged in fire setting with the intention of causing serious damage 9. has deliberately destroyed others' property (other than by fire setting)
<p>Deceitfulness or theft</p> <ol style="list-style-type: none"> 10. has broken into someone else's house, building, or car 11. often lies to obtain goods or favors or to avoid obligations (i.e., "cons" others) 12. has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)
<p>Serious violations of rules</p> <ol style="list-style-type: none"> 13. often stays out at night despite parental prohibitions, beginning before age 13 years 14. has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period) 15. is often truant from school, beginning before age 13 years
<p>Subtypes</p> <p>Childhood-onset type: Individuals show at least one symptom characteristic of conduct disorder prior to age 10 years.</p> <p>Adolescent-onset type: Individuals show no symptom characteristic of conduct disorder prior to age 10 years.</p> <p>Unspecified onset: Criteria for a diagnosis of conduct disorder are met, but there is not enough information available to determine whether the onset of the first symptom was before or after age 10 years.</p>

The body of research supporting the distinction between childhood-onset and adolescent-onset groups can be summarized by two key points. Firstly, there are important differences in the life-course trajectory of the two groups; childhood-onset group is more likely to show aggressive behavior and symptoms in childhood and

adolescence and is more likely to continue to show antisocial and criminal behavior into adulthood (Frick & Nigg, 2012). Secondly, these two groups differ on a number of the risk factors related to CD (Frick, 2004).

Consequences of Childhood-onset CD

“conduct disorder is a serious problem when it affects a child under 10 because early-onset problems are more likely to persist as the child grows up.”

- Ji Su Hong, Washington University School of Medicine in Dryden (2015, para. 10)

CD is an important mental health problem for many reasons, firstly it often involves physical aggression, which is highly related to criminal behavior and it is associated with a host of other social, emotional, and academic problems (Frick, 2016). Secondly, CD in childhood predicts problems later in adulthood which include: mental health problems (e.g., substance abuse); legal problems (e.g., risk for arrest); educational problems (e.g., school drop-out); social problems (e.g., poor marital adjustment); occupational problems (e.g., poor job performance) and physical health problems (e.g., poor respiratory function) (Frick, 2016).

The childhood-onset group starts displaying mild conduct problems as early as pre-school or early elementary school. For instance, young children in age groups of 3-7 years with CD show a general defiance of adult’s wishes, disobedience, angry moods and outbursts, physical aggression to siblings or peers, arguing, blaming and a propensity to irritate and provoke others (Reading, 2013). Apart from these symptoms, in middle childhood (8-11 years) other behaviors include: swearing, lying, stealing, persistent rule breaking, bullying and being mean to others, physical fights and being cruel to animals

and setting fires (Reading, 2013). In adolescence, from 12 to 17 years, more antisocial behaviors occur, like being cruel to and hurting other people, assault, robbery, breaking and entering houses, stealing from cars, stealing vehicles, running away from home, often truanting from school and using drugs and alcohol (Reading, 2013).

It is reported that not all children who experience the behaviors listed in early childhood phase, progress to the later, more severe forms. For instance, it is reported only half of the CD behaviors in early childhood progress to middle childhood, and from there only half of them progress to show CD symptoms listed for adolescence (Rowe, Maughan, Pickles, Costello & Angold, 2002). Another study found that significant portion of childhood-onset youth desist from crime by early adulthood (Odgers et al., 2007). However, the childhood-onset group has been found to be of crucial significance, as they are more likely to exhibit the most severe symptoms in adolescence and adulthood (Reading, 2013).

Studies show that a vast majority of adults with ASPD have a history of CD (INSERM Collective Expertise Centre [ICEC], 2005). Estimates of probability that children with CD will go on to develop ASPD range from 40% to 70% (Steiner & Dunne, 1997; Gelhorn, Sakai, Price, & Crowley, 2007). Another study using logistic regression to examine associations of childhood-onset CD with ASPD found that childhood-onset respondents were more likely than adolescence-onset respondents to endorse CD symptoms involving aggression against people, animals, and property before age 15, and lifetime violent behaviors (Goldstein, Grant, Ruan, Smith & Saha, 2006). The study further revealed that childhood-onset CD identified a more polysymptomatic and violent form of ASPD (Goldstein et al., 2006).

In addition, a link between childhood-onset CD and adult criminality is well established (Robins, 1978; Farrington, 1990; Engqvist & Rydelius; 2007). It is estimated that even though early starters represent just 6-7% of the population, yet they are responsible for almost half of adolescent crime and three-fourths of violent crimes (Offord, Boyle, & Racine, 1991). For instance, in a New Zealand birth cohort followed into adulthood, the rate of convictions for violent acts in adulthood before 32 years of age was 32.7% for men who showed serious conduct problems in childhood, 10.2% for men who displayed serious conduct problems in adolescence and 0.4% for men who did not show serious conduct problems in either childhood or adolescence (Odgers et al., 2007).

Highlighting the seriousness of the early-onset CD, Children's Mental Health Ontario (CMHO) stated that “although children with early-onset CD compose only 3% to 5% of all youth with conduct disorder, they appear to be responsible for at least half of the illegal offenses committed by juveniles” (2001). Similarly, a study carried out on Russian juvenile delinquents in the US found that 23.5% of the total sample reported at least one criterion for CD being present before the age of 10 years. The study also revealed that this group had higher rates of psychopathology, particularly externalizing behaviors, as compared with youths whose conduct problems began at or after the age of 10 years (Ruchkin, Kuposov, Vermeiren & Schwab-Stone, 2003).

Further, it is estimated that 5% of the most antisocial children aged seven years, are up to 500 to 1000% more likely to experience serious life failures at 25 years (Fergusson, Horwood, & Ridder, 2005). For instance, childhood-onset CD youth tend to experience academic and peer difficulties over time which hinder this group from making significant life transitions like graduating, which further pushes them into a criminal

lifestyle (Moffitt et al., 2008). In a sample of young children, aged 4 and 5, presence of CD predicted significant behavioral and educational difficulties five year later (Kim-Cohen et al., 2009).

Additionally, childhood-onset respondents display significantly elevated odds of lifetime social phobia, generalized anxiety disorder, drug dependence, paranoid, schizoid, and avoidant personality disorders (Goldstein et.al., 2006). For example, in the New Zealand birth cohort followed into adulthood, boys who showed CD in childhood were 3.2 times more likely to have an anxiety disorder, 2.9 times more likely to have major depression, 7.8 times more likely to be homeless, 3.6 times more likely to be dependent on alcohol, 2.7 times more likely to be convicted of criminal offences and 25 times more likely to have attempted suicide by age 32 years compared to boys without CD (Odgers et al., 2007).

Furthermore, childhood conduct problems that persist throughout adolescence and adulthood, in the form of antisocial behavior, result in significant amount of harm to the members of the society and the overall society (Shaw, 2013). For instance, children with severe conduct problems are more likely to require remedial help at primary and secondary school; are up to 10 times more likely to leave with no educational or vocational qualifications and will make significantly more use of primary care services (Edwards, C  illeachair, Bywater, Hughes, & Hutchings, 2007; McGroder & Hyra 2009; Furlong et al. 2013). It is estimated that by the age of 28 years, the cost of health, social, education and legal services may be 10 times higher for individuals with a clinical diagnosis of CD at the age of 10 years (EUR 104,416; GBP 70,019; USD 137,450) than for those without these problems (EUR 11,069; GBP 7423; USD 14,571). The costs for

those with non-clinical conduct problems at age 10 years have been found to be 3.5 times higher (EUR 38,836; GBP 35,311; USD 57,311) (Scott, Knapp, Henderson & Maughan, 2001; Fergusson et al., 2005).

The severe consequences of childhood-onset CD underscore the importance of understanding the factors that put young children at risk of developing childhood-onset CD.

Prevalence of Conduct Disorder

Adding to the seriousness of CD is the fact that it is highly prevalent (Frick, 2016). Based on large-scale community-based epidemiological surveys in the US, the UK and Canada, the estimated prevalence rate of CD is 4.2% (Waddell, Wong, Hua & Godderis, 2004). Internationally, CD is considered the most common reason for psychiatric assessment of children or adolescents; in some cases, 30% to 50% of all referrals to child psychiatric units tend to involve CD (Kazdin, 1985). Precise prevalence rates of CD are difficult to obtain as the criteria for the diagnosis of CD vary widely, its manifestations at different developmental stages differ and because the databases of different studies are not uniform, the prevalence estimates reported in several studies vary widely (Sarkhel, Sinha, Aroa and DeSarkar, 2006). In addition, there is comorbidity of CD with Attention-Deficit Hyperactivity Disorder (ADHD), depression, anxiety and learning disabilities, which makes it difficult to isolate and to establish the prevalence of CD (Tervo, 2005).

In the UK and the US, approximately 5% to 10% of children between 5 and 15 years of age are present with clinically significant conduct problems (Loeber &

Farrington, 2001; Task Force, 2006). Some cases of CD begin in early childhood, often by the preschool years and a cross-sectional data study in three different samples found that 3% of the preschoolers may be affected by CD (Copeland, Angold, Costello, & Egger, 2013). The prevalence of CD among elementary-school-aged boys was between 4% and 9% in several countries (Costello, 1989). This research would try to determine the prevalence of childhood-onset CD in Canada based on the DSM-5 cut-off.

Risk Factors for Conduct Disorder

There are multiple causal factors that underlie the behavioral manifestations of CD in children and it is reported that “while causal heterogeneity is common to all psychiatric disorders, the myriad of different etiological factors linked to CD is striking (e.g., genetic, neurocognitive, temperamental, peer, family)” (Pardini & Frick, 2013). Frick has summarized the wide range and large number of risk factors that has been associated with CD (Table 2).

Table 2 Summary of the Major Risk Factors Associated with Conduct Disorder

Dispositional Risk Factors	Contextual Risk Factors
Neurochemical abnormalities	Pre-natal exposure to toxins
Autonomic irregularity	Early exposure to poor quality child care
Birth complications	Parental psychopathology
Difficult child temperament	Family conflict
Impulsivity	Inadequate parental supervision and discipline
Preference for dangerous and novel activities	Lack of parental involvement and neglect
Reward dominant response style	Peer rejection
Low verbal intelligence	Association with a deviant peer group
Academic underachievement	Impoverished living conditions
Deficits in processing social information	Exposure to violence

A body of research suggests that childhood-onset and adolescent group differ on a number of dispositional and contextual risk factors listed in Table 2, that appear to implicate different developmental processes leading to the disruptive behavior in the two groups (Frick, 2004). For instance, most of the dispositional (e.g., temperamental risk, low intelligence) and contextual risk factors (e.g., family dysfunction, poverty) has been found to be associated with severe antisocial behavior seem primarily associated with the childhood-onset subtype (Frick, 2004). Whereas the individuals in the adolescent-onset group are not consistently associated with these risk factors.

Risk Factors for Childhood-Onset Conduct Disorder

Male gender

During childhood, there is a consensus among researchers that the development of disruptive and aggressive behaviors is slightly more prevalent among boys than girls, and boys generally display more risk factors early in their development (e.g., hyperactivity, learning and developmental disorders) (Tremblay, 2010). Male gender has been found to be a significant risk factor for childhood-onset CD (McCabe et al., 2001; Goldstein et al., 2006). It is estimated that males are 2.26 times more likely to have early-onset than females in the study (McCabe et al., 2001).

Moffitt (2003) suggests that there seems to be empirical findings to support that significantly more boys have an early-onset of CD than girls. The lower rate of childhood-onset CD in girls has been explained by concluding that fewer risk factors may be present for girls than boys (Moffitt, 2003). The difference in the prevalence rates can also be explained in terms of childhood reinforcement of aggressive behavior, as parents

are more likely to reinforce girls for pro-social behavior than boys (Snyder, Reid, & Patterson, 2003).

Low income

Low income/poverty, is a significant risk factor for childhood-onset CD (Tremblay, 2010). There is an association between severe poverty and early-childhood conduct problems (Murray & Farrington, 2010). Children from most economically disadvantaged families appear to be at the greatest risk of developing behavior disorders including CD (NASEM, 2015). In the UK researchers found that CDs were the most common mental health disorders among low SES children. In the same study, using occupation status to measure social class as measure of poverty, the prevalence of CD was found to be 10.1%, which was greater than other mental health disorders (NASEM, 2015).

D'Onofrio et al., (2009) has emphasized the importance of identifying family income as a crucial risk factor for development of early-onset CD. Morris and Gennetian's evaluation of the Minnesota Family Investment Program (MFIP) provides strong support for a causal relationship between poverty and children's conduct problems. The evaluation of the MFIP program was carried out by random assignment of welfare recipients with young children into a treatment group, receiving employment training and financial supplements, or a control group, receiving aid for families with dependent children. Recipients in the treatment group with increase in maternal employment accompanied with greater income saw a moderate reduction in conduct problems of their children when compared to the control group (Morris & Gennetian,

2003). Thus, findings from this body of research suggest that “the association between poverty and Conduct Problem (CP) is not simply a spurious link between risk factors associated with low income that may also influence CP, but that low income itself serves as a risk factor for increased CP” (Shaw & Shelleby, 2014, p. 507).

However, some studies also suggest that the association between poverty and childhood conduct problems is indirect, mediated through family situations like ineffective parenting and marital discord (Maughan, 2001). Longitudinal and experimental studies provide three lines of evidence for three types of family mediators which influence children’s behavior problems (Mazza et al., 2016).

First line of evidence shows that poverty is linked to children’s behavior problems (2-6 years age) primarily through less-supportive parenting (Rafferty & Griffin, 2010). A study found a small but significant correlation between conduct problems and poverty, when other variables like education was controlled (Norberg, 2010). The study revealed additional stress caused by poverty affects parenting skills.

Secondly, low-income is associated with child behavior problems through maternal depression among children aged 2-4 years (Wadsworth et al., 2013) and among children aged 7-8 years (Shelleby et al., 2014). For example, a longitudinal study of boys from urban, low-income families followed from ages 1.5 to 10 revealed that the chronic conduct problem group was characterized by lower maternal age, higher maternal depression, maternal rejection and higher child fearlessness (Shaw, Lacourse & Nagin, 2005).

Thirdly, poverty is shown to be related to higher levels of conduct problems (8-10 years) through increase in family conflicts (Evans & English, 2002). Together these three

lines of evidence indicate that “the stress accompanying poverty may lead to harsher and less responsive parenting, conflicted family interactions as well as feelings of hopelessness due to lack of choices in life and, consequently, depressive symptoms. These factors, in turn, may be harmful to children’s behavioral development” (Mazza et al., 2016, p. 2).

Negative/ineffective parenting

Poor parenting is a significant risk factor for conduct problems (Furlong et al., 2013). When coercive interactions dominate within the family, it is reported that child conduct problems emerge and then stabilize throughout development (Granic & Patterson, 2006). Coercive family processes amplify oppositional/aggressive behaviors in early childhood (Smith et al., 2014). A parent and a child can engage in coercive process as early as when the child is two years old (Snyder et al. 2003).

Patterson at the Oregon Social Learning Centre has developed the coercion theory which explains a process of mutual reinforcement during which parents’ put demands on children in a negative and hostile way (Patterson, 1982). To which the child reacts with aggression which in turn leads to increased hostility and negativity from parents’ side (Norberg, 2010). The child responds with increasing anger, and the parents back off, feeling the demand is not worth the commotion it is causing. However, in this way aggression becomes a learnt behavior, where child realizes that if he/she reacts with anger the parent will back off (Patterson, 1982). Thus, children learn a pattern of relating within family that then carries over into interactions with others outside the family, such as peers and teachers in the school setting (Smith et al., 2014).

Abuse & Physical punishment

Abuse (physical & sexual) has been found to be a major risk factor for development of CD and in a study 50% of the participants aged between 10-19 years with a history of abuse met the diagnostic criteria for CD (Lyttle & Brodie, 2006). Lytton (1997) in his article titled “*physical punishment is a problem, whether Conduct Disorder is endogenous or not*” reported that severe and frequent physical punishment has been found to be related to externalizing behaviors like CD. In similar lines, studies have found that harsh punishment may lead to increased externalizing behavior in children (Moffitt, 1993; Essau, 2003), especially increased externalizing behaviors from 36 months to first grade (Mulvaney & Mebert, 2007).

Maternal depression

In the literature, maternal depression is another significant factor which promotes children’s conduct problems (Scott, 2012). The UK’s Environmental Risk (E-Risk) longitudinal twin study suggested that depressed mothers provide inept parenting which promotes children’s aggression at ages 5 and 7 (Kim-Cohen, Arseneault, & Caspi, 2005). A temporal analysis showed that if E-risk mothers experienced depression only before childbirth, the children were not unusually aggressive. In contrast, if mothers suffered depression while rearing their children they were likely to develop aggression.

Family dysfunction & Conflict between parents

Families are considered to be dysfunctional when they are characterized by poor or little communication among family members and when ineffective problem solving approaches are used (Identification of vulnerable children”, n.d.). Having a dysfunctional

family increases the risk of developing childhood-onset CD. For instance, in a sample of families of 102 boys, aged 7-11, CD was highly associated with family dysfunction (Schachar & Wachsmuth, 1991). Family dysfunction, in this study, was measured by the Family Assessment Measure (FAM) which assesses seven dimensions of family function: task accomplishments; communication; role performance; affective expression; affective involvement; control and values and norms.

In addition, some studies suggest that persistent and serious conflicts between parents (primary caregivers) enhance the risk of CD in children (Matthews, 2011). For instance, increase in family conflicts have been found to be related to higher levels of conduct problems among children in the 8-10-year old age group (Evans & English, 2002).

Exposure to violence in home (television violence & adults fighting)

In the literature, television violence viewing is one of the factors that independently contributes to the development of aggressive behavior (Dubow & Miller, 1996). Longitudinal studies focusing on violent content on television and antisocial behaviors have come up with mixed results (Roberston, McAnally & Hancox, 2013). For instance, exposure to violence on television during preschool years have been found to predict antisocial behavior among 7-to-10 year old's (Christakis & Zimmerman, 2007) and viewing television violence among 8-to-9 years-old's have been found to be related to aggression in early adulthood (Huesmann, Moise-Titus, Podolski & Eron, 2003). However, another two longitudinal studies did not find meaningful association between

watching violent television and later antisocial behavior (Roberston, McAnally & Hancox, 2013).

Further, children exposed to interpersonal violence in the home may also learn to use violence in their lives (Hotton, 2003). A Canadian study using NLSCY 1994/95-1998/99 longitudinal sample (6- 11 years) found that exposure to violence in the home has a strong association with aggressive behavior among children (Hotton, 2003). Even after controlling for socio-demographic, social support, parenting and child emotional problems, children who witnessed violence in home had double the odds of behaving aggressively (2.2) than children who never witness violence (Hotton, 2003).

Family structure: single-parent households

Children from single-parent families tend to be less highly monitored which put them at risk of developing CD (Chilcoat & Anthony, 1996). A UK longitudinal study of CD in preschool children five years of age revealed that children diagnosed with CD were disproportionately likely to come from backgrounds marked by low social class, single parenthood, family disruption and parental psychopathology (Kim-Cohen et al., 2005). Similarly, researchers at the Washington University School of Medicine in a longitudinal study found that nearly 57% of the children with CD in ages 6 to 9 years came from either single-parent homes or did not live with either parent and about 42% of them were from families with low incomes (at or below \$20,000 a year) (Hong, Tillman, & Luby, 2015).

Very young mothers & Low education

Apart from poverty, family dysfunction and harsh parenting, other family characteristics related to the mother like the mother being young at the birth of her first child and mother's low educational attainment have been found to be risk factors for CD (ICEC, 2005; Norberg, 2010). Particularly, teenage mothers are often single parents with difficult life circumstances like low income, low educational attainment, poor housing etc., that directly affects the wellbeing of their children (Tervo, 2005).

For instance, a large UK longitudinal population-based cohort of children followed from the prenatal period to age 13, revealed that significant family risk factors in boys with early-onset persistent conduct problems and childhood-limited conduct problems were: lower levels of maternal education and higher levels of teenage motherhood; maternal trouble with police; and smoking during pregnancy (Barker & Maughan, 2009). For girls, significant predictors included low socioeconomic status and not married but cohabiting mothers (Barker & Maughan, 2009).

Ethnicity & Place of residence (urban & rural)

It is reported children from ethnic minorities have a greater risk of living in negative family environments (Canino, Polanczyk, Bauermeister, Rohde, & Frick, 2010). For instance, ethnic minorities in the US have higher exposure to poor prenatal care and are often exposed to many stressful circumstances related to poverty, all of which are associated with CD (Canino et al., 2010). In another study, ethnicity showed relation to CD symptoms in a school environment (Olsson, 2009). In addition, living in an urban environment may increase child's risk of developing childhood-onset CD. It is reported

that CD is more prevalent in urban areas as opposed to rural areas (Nock; Kazdin; Hiripi; Kessler, 2006).

Comorbid ADHD

Having a diagnosis of ADHD is a significant predictor of CD onset before age 12 and it is estimated that children who meet the criteria for a comorbid diagnosis of ADHD are about two and a half times more likely to have childhood-onset CD as those without ADHD (McCabe et al., 2001). CD tends to be more severe and persistent when children also exhibit ADHD (Cantwell & Baker, 1992). In addition, it has also been argued that antisocial adults have childhood histories of both CD and ADHD, rather than childhood histories of only CD or ADHD (Lynam, 1996).

Summary

A review of literature reveals that childhood-onset CD is a serious problem with serious consequences and there are multiple risk factors associated with this disorder. Many risk factors have been identified to correlate with CD. This research will add to the literature on childhood-onset CD in Canada by quantitatively assessing the impact of multiple risk factors contained in the NLSCY on childhood-onset CD.

Methodology

To analyze the risk factors for childhood-onset CD using the NLSCY dataset requires identification of survey variables relevant to the research question. In NLSCY neither a diagnosis of childhood-onset CD nor a comprehensive measure of a child's environment and other risk factors are directly available. Data analysis for this thesis started with defining the dependent variable and independent variables present in the NLSCY. This chapter examines the methodology used in this thesis by enlisting the suitable dependent and independent variables from Cycle 1. To check the reliability and validity of the findings from Cycle 1, we replicated the research for the NLSCY Cycle 3 as it has identical questions on CD symptoms and identical independent variables shortlisted for Cycle 1. Cross-sectional data for Cycle 1 (1994-1995) and Cycle 3 (1998-1999) were used in this study for children aged 4-10.

Gaining Access to the NLSCY

Access to the NLSCY is mediated through Statistics Canada's Research Data Centers (RDC) affiliated with universities across Canada. To gain access to the NLSCY data file, application with a proposal highlighting the objectives of the thesis was submitted. Application to access the data file was granted after Statistics Canada was satisfied regarding the feasibility as well as importance of the research question addressed in the proposal.

The National Longitudinal Survey of Children and Youth: Cycle 1 & 3 (1994-95, 1998-9)

The *National Longitudinal Survey of Children and Youth* (NLSCY) is a long-term study of Canadian children that follows their development and well-being from birth to early adulthood spaced at two-year intervals. The first Cycle of the NLSCY was conducted by Statistics Canada in 1994-1995 on behalf of Human Resources Development Canada (HRDC).

The target population for Cycle 1 consisted of children newly born to 11 years of age in Canada's 10 provinces. Cycle 1 consisted of both computer-assisted interviews and paper and pencil questionnaires. The computer-assisted interviews were conducted both over telephone and face to face, with all data being entered in a computer. The Person Most Knowledgeable (PMK) about the child filled out the whole survey for children under the age of 10, whereas children over the age of 10 filled out some questionnaires by themselves. There were 12,588 children in Cycle 1 giving a weighted sample of 2.7 million children.

In Cycle 3, there were two main samples- the longitudinal sample and a cross-sectional sample. The longitudinal sample comprised of children from Cycle 1 who were 8-14 years old in Cycle 3. The cross-sectional sample population consisted of children aged 0 to 11. For this study the cross-sectional sample in Cycle 3 was used for replication. There were 15,076 children in the cross-sectional sample of Cycle 3, giving a weighted sample of 2.8 million children.

Weights

In the NLSCY “the principle behind estimation in a probability sample such as the NLSCY is that each person in the sample “represents”, besides himself or herself, several other persons not in the sample” (Statistics Canada, 2002, p. 57). The weighting phase is a step which calculates, the number of individuals in the population represented by each child in the survey. The advantage of the NLSCY data is that the children have been assigned survey weights which can account for: unequal selection probabilities; unit non-response; under-coverage and over-coverage in the frame; and auxiliary information about the population. Appropriate weighting reduces estimation bias in the “first order statistics” (e.g. means, ratios).

Weights appear on the NLSCY micro data file and cross-sectional weights were employed to obtain the descriptive statistics in this analysis to ensure that the statistics accurately represent the national population under study. There is consensus in the literature that weights should be used for descriptive statistics (Kish & Martin, 1974). However, there is less consensus on whether weights should be used in regression (Gelman, 2007; Kott, 2007). Thus, in this analysis for estimating Linear Probability Model and Logit regression unweighted data was used.

Missing Values

Every question in the NLSCY carries its own range of responses and non-responses (missing values). Missing values were designated as “Don’t know”, “Refusal”, or “Not stated” in the NLSCY survey. If on the variables included in this study the PMK’s responses were “Don’t know”, “Refusal”, or “Not stated”, they were excluded

from the analysis. In Cycle 1 out of the total sample size of 12,588 children (unweighted) between the ages 4-10 years, 438 children were excluded from the analysis in Model 1 and Model 2 and in Model 3 and Model 4 around 818 children were excluded from the analysis. In Cycle 3 out of the total sample size of 15,076 children (unweighted), about 396 children were excluded in Model 1, about 916 children in Model 2 and around 1,486 children in Model 3 and Model 4.

Defining Dependent variable: Childhood-onset CD

The Diagnostic and Statistical Manual of Mental Disorders (DSM), and the *International Classification of Diseases and Related Health Problems (ICD)* (WHO, 1994) are the standard references for researchers and clinicians throughout the world. This research is using the definition given by DSM-5 for childhood-onset CD which is “Individuals show at least one symptom characteristic of conduct disorder prior to age 10 year” (APA, 2013).

The NLSCY Cycle 1 has incorporated several questions dealing with behavior related to CD. However, since the specific childhood-onset CD variable does not appear directly in any of the data set, a latent variable is required for this purpose constructed from the survey responses. The dataset contains several pre-computed scale variables or ‘scores’ where each one is a latent variable incorporating several related behavior variables. None of these scales directly describes childhood-onset CD as defined by the DSM-5. Thus, it was necessary to create a childhood-onset variable for this research.

The DSM-5 definition of CD organizes behaviors into four categories: 1. Aggression to people and animals 2. Destruction of property 3. Deceitfulness or theft 4.

Serious violation of rules. Not all the described behaviors identified in the NLSCY exactly match the DSM-5 definitions, and some overlap is present. Particularly for the desired age group for this research (children under 10 years), NLSCY variables related to fire setting, cruelty to animals, assault with a weapon and forced sex are not available. However, sufficient number of variables exist in the NLSCY to span a range of behaviors related to childhood-onset CD as defined by the DSM-5. Table 3 shows the comparable DSM-5 variables available in NLSCY Cycle 1 and 3 for children in the age group of 4-10 years.

Table 3 NLSCY Cycle 1 &3 Comparable DSM-V Symptoms

DSM V Conduct Disorder	NLSCY CD Questions (4-10 years)	Variable**
I. Aggression to People and Animal		
1. Often bullies, threatens, or intimidates others.	Threatens people? Is cruel, bullies or is mean to others?	ABECQ6FF ABECQ6JJ
2. Often initiates physical fights.	Gets into many fights? Reacts with anger and fighting?	ABECQ6G ABECQ6X
3. Has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun).		
4. Has been physically cruel to people.	Physically attacks people? Kicks, bites, hits other children?	ABECQ6AA ABECQ6NN
5. Has been physically cruel to animals.		
6. Has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery).		
7. Has forced someone into sexual activity.		
II. Destruction of Property		
8. Has deliberately engaged in fire setting with the intention of causing serious damage		

9. Has deliberately destroyed others' property (other than by fire setting).	Destroys his/her own things? Destroys things belonging to his/her family, or other children? Vandalizes?	ABECQ6C ABECQ6L ABECQ6DD
III. Deceitfulness or Theft		
10. Has broken into someone else's house, building, or car.		
11. Often lies to obtain goods or favors or to avoid obligations (i.e., "cons" others).	Tells lies or cheats?	ABECQ6T
12. Has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)	Steals at Home? Steals outside the home?	ABECQ6E ABECQ6PP
IV. Serious Violations of Rules		
13. Often stays out at night despite parental prohibitions, beginning before age 13 years.	Stayed out all night without permission?*	ABECQ7B
14. Has run away from home overnight at least twice while living in the parental or parental surrogate home, or once without returning for a lengthy period.	Ever run away from home? *	ABECQ7F
15. Is often truant from school, beginning before age 13 years.	Skipped a day of school without permission? *	ABECQ7C

*(only 10-year old's asked this question)

** In Cycle 3 the variables start with the letter 'C'

Most of the NLSCY questions relating to CD symptoms return a three-level response ("never or not true", "sometimes or somewhat true", "often or very true"). The NLSCY variables describing "serious violation of rules" have four levels ("never", "once", "twice", "more than twice"). For defining childhood-onset CD, in this research a child was considered to have a given symptom if the PMK reported the symptom as being "often or very true" (Lacourse et al., 2010) and for questions on "serious violation of rules" if the PMK reported "more than twice". Consistent with the DSM-5 definition,

childhood-onset CD was defined as having at least one symptom of CD beginning prior to age 10 (McCabe et al., 2001).

A binary response variable was created in STATA as our dependent variable from the survey questions as described above. Answering ‘often or very true’ to any of the questions on CD symptoms causes dependent variable to be 1 or else it is 0.

Independent Variables Created or Utilized

Based on the literature review and the NLSCY questions, many risk factors were included in this study as independent variables. There are thousands of questions asked in the NLSCY, however a relatively limited number of them apply to this research.

male gender

Gender of the child is available for all children in the NLSCY and refers to the sex of the child. It is directly measurable from the survey data as a string variable indicating ‘male’ or ‘female.’ This variable was recoded 1 for males and 0 for females. The NLSCY Cycle 1 has approximately an equal number of boys and girls.

ethnicity

In the NLSCY Cycle 1 child questionnaire, the PMK was asked questions on the ethnicity of the child from which five dichotomous variables were created. Children belonging to ethnic groups such as: Canadian; French; English; German; Scottish; Irish; Italian; Ukrainian; Dutch; Polish and Portuguese were combined to create a dichotomous variable “Caucasian.” Children belonging to Chinese and South Asian ethnicity were recoded as “Asian.” Responses of PMK’s who answered Black were used to create a

dichotomous variable “Black.” Children belonging to North American Indian, Metis and Inuit were grouped together to create a variable “Aboriginals.” Children who were Jewish and answered “Other” for ethnicity were recoded as “Other.”

place of residence

A variable called “Province of residence” is readily available for all the children in the survey, which shows the province in which the child was living during data collection. To know the urban/rural status of the child a dichotomous variable was created from the variable “Urban-Rural Code” and was recoded 1 for urban and 0 for rural.

low income adequacy

Income adequacy was determined according to Statistics Canada’s derived variable of household size and income in Cycle 1. The lowest two categories were combined to indicate low income adequacy, a dichotomous grouping that closely corresponds to Canada’s Low income cut-offs (LICO) in 1995 (Charach, Hongmei, Schachar, To, & Cao, 2006).

poor neighborhood

Poor neighborhood was recorded as present (1) or absent (0) in response to the question “How do you feel about your neighborhood as a place to bring up children?” PMK who responded poor/very poor for the above question were coded 1 and who responded excellent/good/average were coded 0. As this variable is highly correlated with

low income it was not included in regressions, but was only used to obtain descriptive statistics.

single parent/ orphans

In the NLSCY details concerning family structure are available in several questions determining the number of parents in the household. The dichotomous variable ‘Single parent/Orphans’ was recoded from the categorical ‘family structure variable.’ Children living in single parent households or orphans were coded as 1 and children living in two-parent households were coded as 0. It must be noted that children who were orphans were just 0.1% of the total sample and they were combined with single-parent households to not exclude them from the analysis.

mothers age group

Mother’s age group at the birth of the child with childhood-onset CD is directly measurable from the survey data and there are five age groups: 15-24; 25-29; 30-34; 35-39; and 40+.

low parental education

Low parental education variable is a dichotomous variable with PMK’s who had less than high school education coded as 1 and PMK’s with more than high school education coded as 0 (Charach et al., 2006).

parental smoking

Parental smoking for either parent was recorded as present or absent in response to the question, “At the present time do/does you/he/she smoke cigarettes daily, occasionally or not at all?” (Charach et al., 2006).

parental alcohol use

Parental alcohol use was considered positive if the frequency of alcohol consumption for either parent was more than once monthly (Charach et al., 2006).

family dysfunction

The NLSCY’s user guide for the 1st Cycle (1994-1995) regarding the family functioning scale states: “This scale is used to measure various aspects of family functioning, e.g. problem solving, communications, roles, affective involvement, affective responsiveness and behavior control. This scale is aimed at providing a global assessment of family functioning and an indication of the quality of the relationships between parents or partners.” The family functioning scale varies from 0 to 36 with higher score indicating higher levels of family dysfunction. Family functioning was treated as a continuous variable to obtain the descriptive statistics. To determine the association between childhood-onset CD and family dysfunction a dichotomous variable was created where a family with a score of 15 and above was coded as dysfunctional family (l’Institut de la statistique du Québec, 2000).

maternal depression

Depression is available as a pre-defined depression score, ranging between 0 to 36, based on several questions asked directly to the PMK. In the Cycle 1, in most cases the PMK was mother (for 91.3% of responding children, the PMK was the mother) (“NLSCY,” 2008), thus in this thesis the depression score will be referred as ‘maternal depression.’ For regression analysis, maternal depression was measured as a dichotomous variable— PMK’s who scored 9 or above were coded 1 (depressed), and PMK’s who scored 8 or less were coded 0 (not depressed) (Somers & Willms, 2002).

negative parent/child relationship

Negative parent/child relationship was examined on dimensions including: (1) hostile ineffective parenting, (2) Positive interaction, (3) Consistency, (4) Use of Physical punishment, and (5) Yelling at child.

The *hostile-ineffective* parenting variable is a predefined score which targets the parent’s disciplinary practices and how they react to their children. The score ranges from 0-28, where a higher score indicates increased frequency of annoyance, disapproval, anger, behavior management problems and decreased frequency of praise (Lipman, 1998).

Positive interaction score refers to the warm and nurturing parenting (e.g. “How often do you praise your child saying something like ‘Good for you!’ or ‘What a nice thing you did!’ or ‘That’s good going!’?” and “How often do you and your child talk or play with each other, focusing attention on each other for 5 minutes or more, just for fun?”). The total score ranges between 0 and 20, a high score indicative of more positive

interaction between the child and the parent. For ease of interpretation in this thesis, this score was reverse coded so that higher scores were indicative of less positive interaction (negative interaction).

Consistency refers to the degree to which parents follow through with requests or threats of discipline(e.g. “When you give your child a command, what proportion of the time so you make sure that he/she does it?” and “When your child breaks the rules or does things that he/she is not supposed to, how often do you ignore it, do nothing?”) (Sommer, Whitman, Borkowski, & Gondoli, 2000). The total score varies between 0 and 20, a high score indicating consistent parenting. In this thesis, this score was reverse coded so that higher scores were indicative of inconsistent parental behavior, for ease of interpretation.

The above mentioned predefined variables did not include questions on yelling at the child and use of physical punishment. *Yelling at child* was measured as a dichotomous variable —parents who answered ‘always’ or ‘often’ to yelling at child were coded 1 and rest were coded 0 (absence of yelling). A child was identified as positive for *physical punishment* if the PMK answered ‘always’ or ‘often’ for using physical punishment when the child breaks rules or does things he/she is not supposed to do.

abuse

A child was identified to have experienced abuse if the PMK answered yes to the question “Has child ever experienced...abuse/fear of abuse.” This variable does not specify whether the child experienced physical or sexual abuse. This variable could be

highly correlated with physical punishment; thus, it was only used for descriptive statistics and dropped in the regression to avoid the problem of multicollinearity.

exposure to violence in home

The extent of violence witnessed by children in home was determined in response to the questions “How often does he/she see adults or teenagers in your house physically fighting, hitting or otherwise trying to hurt others?” (Hotton, 2003) and “How often does he/she see television shows or movies that have a lot of violence in them?” If the PMK answered ‘often’ to any of these two questions the child was coded positive for ‘exposure to violence’ in home.

conflict between parents

Conflict between parents for the child was recorded positive if the PMK responded ‘yes’ to the question “Has child ever experienced...conflict between parents.”

ADHD (Hyperactivity-Inattention Score)

The parent-reported NLSCY Hyperactivity/Inattention score which is a predefined score can be used as an indicator for clinically significant ADHD symptoms in children (Charach, Lin, & To, 2010). The total score varies from 0 to 16, a high score indicating the presence of ADHD behavior. To estimate ADHD comorbidity with childhood-onset CD, a score of 9 and above was coded as 1 (presence of ADHD) (Willms, 2002; Currie & Stabile, 2004).

Table 4 lists the independent variables chosen for analysis from the NLSCY survey.

Table 4 Independent Variables

Variable	Description
Gender of the child	Demographics
Ethnicity of the child	Demographics
Province	Demographics
Rural/urban	Demographics
Low Income Adequacy	Demographics
Single parent family	Demographics
Mother's age group at birth of the child	Demographics
Low Mother's education	Demographics
Family dysfunction	Family characteristics
Parental alcohol use	Family characteristics
Parental smoking	Family characteristics
Exposure to violence at home	Family characteristics
Maternal depression	Child experiences
Hostile ineffective parenting	Child experiences
Negative interactions (parenting)	Child experiences
Inconsistent parenting	Child experiences
Yelling at child	Child experiences
Abuse (child)	Child experiences
Physical punishment	Child experiences
Conflict between parents	Child experiences
ADHD	Child experiences

Research Methods

Both descriptive and binary response regression were performed to evaluate the research questions.

Descriptive analysis

Descriptive statistics on prevalence rates of childhood-onset CD by gender, province and number of symptoms in Canada were obtained. Children who had childhood-onset CD were compared with children who did not have childhood-onset CD across several dichotomous variables and continuous variables.

Binary response regression analysis

Our dependent variable childhood-onset CD is a binary variable which can take only two possible values 0 or 1. Thus binary response regressions like Linear Probability Model (LPM), logit and logistic regression (odds ratio) were employed to understand which independent variables have a significant correlation with the presence of childhood-onset CD. The LPM predicts the probability of an event occurring, and, says that the effects of independent variables on the probabilities are linear. Probabilities can only range between 0 and 1.

To deal with the limitations of LPM: some predicted probabilities may have nonsensical values that are less than 0 or greater than 1 (interpreting probabilities that are not bounded by 0 and 1 is difficult) and heteroscedasticity (standard errors in the LPM are biased), logistic regression was used to test for robustness.

The coefficients of logit regression are very difficult to interpret; thus, it is common to report logistic regression results as odds ratios. This study establishes the independent variables that have a significant correlation with the presence of childhood-onset CD, with the odds ratio indicating the strength of any positive or negative correlations. An odds ratio of 1 tells us there is no difference, while odds ratio of greater than or less than 1 indicate that the odds of having childhood-onset CD is worse or better, respectively, for each unit increase in the independent variable. Both the significance of a specific independent variable and the odds ratio (different from 1) reveals if a variable correlates with childhood-onset CD (Tervo, 2005). For this study, Cycle 1 was used for main analysis and Cycle 3 was used for comparison purpose.

Summary

A binary childhood-onset CD variable based on DSM-V symptoms was created from the NLSCY data set as the dependent variable for this study. Several independent variables relating to various environmental factors of interest in a child's life are selected as the independent variables. Both descriptive and regression analysis was conducted to estimate the relationship between the likelihood of childhood-onset CD and the independent variables. The next chapter presents the results of this analysis.

Results

Prevalence of Childhood-onset CD

The prevalence of childhood-onset CD for Canada in NLSCY Cycle 1 was 12.5% representing around 349,000 children (unweighted sample is equivalent to 1,600 children) (Table 5). In Cycle 3 the prevalence of childhood-onset CD was 11.4% with an unweighted sample of 1,800 children representing 324,995 children.

In Cycle 1, children aged 4, 5, 8 and 10 had the highest prevalence of childhood-onset CD (14%, 14% and 15% respectively). Whereas in Cycle 3 youngest children (4-6 years) had the highest prevalence rates for childhood-onset CD (14%, 14% and 13% respectively) (Table A1 of the Appendix). In Cycle 1 the prevalence of childhood-onset CD was the lowest for children aged 7 and 9 (10%). In Cycle 3 it was the lowest for children aged 8 and 9 (9%).

Newfoundland had a prevalence rate of 8% which was the lowest in Canada while Quebec had the highest prevalence rate of 15% (Table 6). New Brunswick had a prevalence rate of 13%. In Cycle 3 Newfoundland continued to have the lowest prevalence of childhood-onset CD (Table A2 of the Appendix).

Table 5 Prevalence of Childhood-onset CD by Age (4-10 years): Cycle 1

Age (years)	Total population	No childhood-onset CD population	Childhood-onset CD population	Prevalence of childhood-onset CD (in %)
4	409,281	351,722	57,559	14%
5	402,432	347,800	54,632	14%
6	389,698	347,430	42,268	11%
7	386,407	346,171	40,236	10%
8	392,133	339,076	53,057	14%
9	396,300	354,934	41,366	10%
10	396,047	336,120	59,927	15%
Total	2,772,298	2,423,253	349,045	12.5%

Table 6 Prevalence of Childhood-onset CD by Province (4-10 years): Cycle 1

Province	Total population	No childhood-onset CD population	Childhood-onset CD population	Prevalence of childhood-onset CD (in %)
NL	54,012	49,726	4,286	8%
PEI	13,787	12,153	1,634	12%
NS	86,991	74,796	12,195	14%
NB	69,092	59,809	9,283	13%
QC	635,345	540,021	95,324	15%
ON	1,041,654	911,897	129,757	12%
MB	115,618	101,273	14,345	12%
SK	111,137	98,436	12,701	11%
AL	297,987	266,161	31,826	11%
BC	69,520	31,826	37,694	11%
Canada	2,772,298	2,423,253	349,045	12.5%

Around 8.6% of the children displayed one CD symptom, 2% of the children displayed two symptoms and 1% of the children displayed three symptoms (Table 7).

Table 7 Childhood-onset CD by number of symptoms (4-10 years): Cycle 1

Number of symptoms	Frequency	Percent
0	2,423,253	87.4%
1	239,634	8.6%
2	56,524	2.0%
3	24,987	0.9%
4	11,381	0.4%
5	5,836	0.2%
6	3,006	0.1%
7	4,795	0.17%
8	984	0.04%
9 or more symptoms	1,898	0.06%
Total	2,772,298	100%

The top symptoms exhibited by childhood-onset population are: reacts with anger and fighting; gets into many fights; destroys own things; lies and cheats; physically attacks people; threatens people; and kicks, hits and bites. The reported prevalence rates of these symptoms are 6.1%, 4%, 2.4%, 2.1%, 1.2%, 1% and 1% respectively (Table 8). In Cycle 3 the list for the top childhood-onset CD symptoms did not change much (Table A3 of the Appendix).

Table 8 Top Five Childhood-onset CD symptoms in Canada (4-10 years): Cycle 1

Rank	Symptom	Frequency	Percent
1	Reacts with anger & fighting	169,952	6.1%
2	Gets into many fights	111,318	4.0%
3	Destroys own things	67,249	2.4%
4	Lies and cheats	59,352	2.1%
5	Physically attacks people	33,487	1.2%
5	Threatens people	26,411	1.0%
5	Kicks, hits and bites	26,371	1.0%

Descriptive Statistics: Dichotomous Variables

Around 15% of boys and 10% of girls were estimated to have childhood-onset CD in Canada (Table 9). Aboriginal children reported the highest prevalence of childhood-onset CD (presence of one symptom) at 21% followed by Caucasian (13%), Black (10%) and Asian (6%) children respectively. Approximately 19% children living in single parent households had childhood-onset CD compared to 11% of children living in two parent families. Around 17% of children in low income households had childhood-onset CD when compared to 11% of children in middle/high income households. Among children living in poor neighborhood, approximately 25% were reported to have childhood-onset CD compared with 12% in good neighborhood.

Among children with low parental education, 17% had childhood-onset CD compared with 11% of children whose parents had education more than high school. Children born to the youngest mothers (15-24 years) and oldest mothers (40+ years) had the highest rates of childhood-onset CD at 16% and 14% respectively. Eighteen percent of children with a depressed PMK were reported to have childhood-onset CD when compared to 11% of children with non-depressed PMK. Similarly, 20% of children living in dysfunctional families had childhood-onset CD when compared to 12% of children in functional families.

Table 9 Mean and Standard Deviation of Dichotomous Variables (4-10 years): Cycle 1

Description	Detail	Total Sample population	Childhood-onset population	Mean	Std. Dev
Gender	1=boys	1,421,154	212,152	0.149	0.356
	0=girls	1,351,144	136,893	0.101	0.031
Ethnicity	Caucasian	2,425,297	319,258	0.131	0.338
	Asian	79,968	4,880	0.061	0.239
	Black	38,407	4,203	0.109	0.312
	Aboriginals	118,890	25,056	0.210	0.407
	Others	522,841	56,293	0.107	0.309
Single Parents/Orphans	1=single parent/orphans	450,231	87,772	0.194	0.396
	0=two parent households	2,322,067	261,273	0.112	0.316
Low parental education	1=less than high school	629,450	111,976	0.171	0.382
	0=more than high school	2,142,848	237,069	0.110	0.313
Low income Adequacy	1=low income	504,274	85,972	0.170	0.376
	0=middle/high income	2,268,024	263,073	0.115	0.320
Mothers age group	15-24 yrs.	639,478	102,724	0.161	0.367
	25-29 yrs.	1,036,431	130,078	0.125	0.331
	30-34 yrs.	740,672	76,336	0.103	0.304
	35-39 yrs.	216,538	18,061	0.083	0.276
	40+ yrs.	40,637	5,797	0.142	0.349
Urban/Rural	1=urban	2,245,600	276,805	0.123	0.328
	0=rural	526,698	72,240	0.137	0.344
Poor neighborhood	1=yes	120,116	29,897	0.24	0.432
	0=no	2,652,182	319,148	0.12	0.325
Parental smoking	1=yes	711,766	109,325	0.153	0.36
	0=no	2,060,532	239,720	0.116	0.32
Parental alcohol use	1=yes	1,055,784	128,447	0.121	0.326
	0=no	1,716,514	220,598	0.128	0.334
Exposure to violence at home	1=yes	145,836	40,036	0.274	0.446
	0=no	2,626,462	309,009	0.117	0.322

Description	Detail	Total Sample population	Childhood-onset population	Mean	Std. Dev
Family Dysfunction	1=family functioning score of 15 and above	271,271	53,114	0.195	0.396
	0= family functioning score of 14 and below	2,501,027	295,931	0.118	0.322
Maternal Depression	1= depression score of 9 above	531,679	97,732	0.183	0.387
	0= depression score of 8 and below	2,240,619	251,313	0.112	0.315
Yell at child	1=yes	704,005	162,032	0.231	0.420
	0=no	2,068,293	187,013	0.092	0.286
Abuse	1=yes	27,826	10,501	0.377	0.484
	0=no	2,744,472	338,544	0.123	0.328
Physical punishment	1=yes	20,999	6,394	0.304	0.460
	0=no	2,751,299	342,651	0.124	0.330
Conflict between parents	1=yes	49,486	13,478	0.272	0.445
	0=no	2,722,812	335,567	0.123	0.328
ADHD	1=Hyperactivity /inattention score of 9 and above	472,121	154,637	0.327	0.469
	0=H/I score of 8 and below	2,300,177	194,408	0.084	0.278

*Means of the childhood-onset CD population for the risk factors are given in bold.

About 27% of children who were exposed to violence at home had childhood-onset CD compared to 11% of other children in the sample who were not exposed to violence. Likewise, 23% of children who were often yelled at had childhood-onset CD when compared to 9% of children who were not often yelled at. Also 38% of children who experienced abuse had childhood-onset CD when compared to 9% of children who

did not experience abuse. Around 30% of children who were often physically punished had childhood-onset CD compared to 12% of children who were not often physically punished. Approximately 32% of children with ADHD had childhood-onset CD when compared to 8% of other children without ADHD in the sample.

In Cycle 3 the means for the childhood-onset CD population were comparatively less for single parent households (0.13), Aboriginal ethnicity (0.15), low parental education (0.15) and low income adequacy (0.14) (Table A4 of the Appendix). This is since the characteristics of the samples in Cycle 1 changed overtime, with the initial sample being less urban, less well educated, and having lower income adequacy than Cycle 3 (Charach et al., 2006). The 1994-1995 sample (Cycle 1) when compared to the 1998-1999 sample (Cycle 3) included: fewer children from urban households (81.7%, compared with 86.7%); more mothers who did not complete high school education (16.3%, compared with 11.7%); and more children from families with low income adequacy (17.7%, compared with 11.7%) (Charach et al., 2006).

Abuse and physical punishment had lower mean values (0.25) in Cycle 3 compared to mean values of (0.37) and (0.30) in Cycle 1. The means for family dysfunction (0.23), conflict between parents (0.37) and ADHD (0.36) were higher in Cycle 3 compared to mean values of (0.20), (0.27) and (0.33) in Cycle 1. Rest of the variables reported similar means in both the cycles.

Descriptive Statistics: Continuous Variables

Children with childhood-onset CD had higher means for all the predefined variables in the NLSCY Cycle 1 when compared to children with 'No childhood-onset

CD' in this study (Table 10 below). Especially children with childhood-onset CD experienced on an average a higher score for hostile-ineffective parenting (11.8 compared to 8.4 for no-CD children), hyperactivity-inattention (7.6 compared to 4.2 for no-CD children), depression (6.6 compared to 4.5 for no-CD children) and family function (9.3 compared to 7.7 for no-CD children). Cycle 3 also had higher means for children with childhood-onset CD when compared to others (Table A5 of the Appendix).

Table 10 Mean and Standard Deviation of Continuous Variables (4-10 years): Cycle 1

Score	Total Sample Population	Mean	Standard Deviation
SES Score (-2.0 to +1.75)			
Childhood-onset CD	349,045	-0.248	0.767
No childhood-onset CD	2,403,860	-0.028	0.777
Depression Score (0 to 36)			
Childhood-onset CD	344,424	6.64	6.691
No childhood-onset CD	2,366,842	4.50	5.363
Family Functioning score (0 to 36)			
Childhood-onset CD	344, 006	9.34	5.740
No childhood-onset CD	2,374,527	7.78	5.114
Hyperactivity-Inattention score (ADHD) (0 to 16)			
Childhood-onset CD	348,458	7.69	4.1470
No childhood-onset CD	2,358,739	4.21	3.2690
Hostile Ineffective Parenting score (0 to 25)			
Childhood-onset CD	347, 223	11.86	4.242
No childhood-onset CD	2,356,380	8.45	3.562
Positive Interaction score (reverse coded to represent less positive interactions) (0 to 20)			
Childhood-onset CD	348,085	7.32	3.219
No childhood-onset CD	2,369,819	6.98	3.035
Consistency (reverse coded to represent inconsistency in parenting) (0 to 20)			
Childhood-onset CD	347,080	6.11	3.764
No childhood-onset CD	2,349,835	4.96	3.367

*Means of the childhood-onset CD population are given in bold.

Binary Response Regression

The independent variables identified in Chapter 3 were added to regression in four models. The first model included the child's demographic variables (gender, age, ethnicity, province of residence, mother's age group at birth of the child, single family status, living in urban area, low parental education and low income). The second model expanded by including some more variables like exposure to violence in home, conflict between parents, parental smoking and parental alcohol use which were not directly related to the child.

Third model expanded to include potentially mediating factors such as: maternal depression, negative parenting and family dysfunction. These factors describe underlying processes where one variable influences another (Tervo, 2005). The fourth model expanded to include ADHD. The variables in model 3 and model 4 maybe endogenous. For instance, negative parent-child interactions including physical punishment and yelling at the child, have been highly related to conduct problems in children (Lytton, 1997). However, some argue that it is the antisocial attitudes displayed by children that provoke harsh parental responses, which in turn, result in increased antisocial attitudes and behavior in children (Lytton, 1997).

The result obtained in the LPM and logistic regression were mostly similar in Cycle 1, which indicates the robustness of our results. Table 11 displays the coefficient table output from the LPM and Table 12 shows the odds ratio associated with independent variables. The results obtained from Cycle 1 were in line with Cycle 3, except for two variables namely single-parent households and physical punishment (see

Table A6 of the Appendix) for coefficients from the LPM for Cycle 3 and Table A for odds ratio obtained for Cycle 3.

We would like to add that the characteristics of the samples in Cycle 1 was less urban, less well educated, and had lower income adequacy than Cycle 3 (Charach et al., 2006). From the literature, it is clear that these demographic factors are very important and children from most economically disadvantaged families appear to be at the greatest risk of developing CD (NASEM, 2015). Due to this reason the risk factors in Cycle 1 seems to be slightly more strongly associated with childhood-onset CD when compared to Cycle 3.

Table 11 Linear Probability Model for Childhood-onset CD (4-10 years): Cycle 1

Variable	Model 1	Model 2	Model 3	Model 4
male	0.052*** (0.005)	0.047*** (0.005)	0.036*** (0.005)	0.019*** (0.005)
Mothers age group (15-24)				
25-29	-0.031*** (0.007)	-0.026*** (0.007)	-0.023*** (0.007)	-0.019*** (0.007)
30-34	-0.048*** (0.008)	-0.041*** (0.008)	-0.032*** (0.008)	-0.027*** (0.008)
35-39	-0.067*** (0.013)	-0.057*** (0.013)	-0.048*** (0.013)	-0.041*** (0.012)
40+	-0.058 (0.031)	-0.046 (0.031)	-0.022 (0.031)	-0.020 (0.030)
Ethnicity Caucasian				
Ethnicity Asian	-0.055** (0.026)	-0.049* (0.026)	-0.026 (0.026)	-0.028 (0.025)
Ethnicity Black	-0.035 (0.032)	-0.028 (0.031)	-0.029 (0.031)	-0.020 (0.030)

Variable	Model 1	Model 2	Model 3	Model 4
Ethnicity	0.068***	0.059***	0.044***	0.034***
Aboriginal	(0.013)	(0.013)	(0.013)	(0.012)
Ethnicity Others	-0.001	-0.003	-0.005	-0.003
	(0.008)	(0.008)	(0.008)	(0.008)
Single_parents _orphans	0.065***	0.071***	0.049***	0.038***
	(0.009)	(0.009)	(0.009)	(0.009)
Age (4)				
5	-0.017*	-0.019*	-0.012	-0.006
	(0.010)	(0.010)	(0.010)	(0.010)
6	-0.028***	-0.029***	-0.022**	-0.016
	(0.010)	(0.010)	(0.010)	(0.010)
7	-0.033***	-0.035***	-0.024**	-0.022**
	(0.010)	(0.010)	(0.011)	(0.010)
8	-0.026**	-0.030***	-0.018	-0.016
	(0.010)	(0.010)	(0.010)	(0.010)
9	-0.04***	-0.045***	-0.033***	-0.02**
	(0.011)	(0.010)	(0.011)	(0.011)
10	-0.006	-0.016	-0.000	0.007
	(0.010)	(0.010)	(0.011)	(0.011)
Province (NL)				
PEI	0.054***	0.051**	0.050**	0.041**
	(0.020)	(0.020)	(0.019)	(0.019)
NS	0.054***	0.050***	0.042**	0.033**
	(0.016)	(0.016)	(0.016)	(0.016)
NB	0.056***	0.055***	0.054***	0.046***
	(0.017)	(0.016)	(0.016)	(0.016)
QC	0.081***	0.080***	0.083***	0.060***
	(0.014)	(0.014)	(0.014)	(0.013)
ON	0.066***	0.061***	0.057***	0.050***
	(0.013)	(0.013)	(0.013)	(0.013)
MB	0.040**	0.042**	0.036**	0.030*
	(0.016)	(0.016)	(0.016)	(0.015)
SK	0.037**	0.032**	0.027*	0.022
	(0.016)	(0.016)	(0.016)	(0.015)
AL	0.040**	0.040**	0.041***	0.035**
	(0.015)	(0.015)	(0.015)	(0.015)
BC	0.055***	0.051***	0.049***	0.043***
	(0.016)	(0.016)	(0.016)	(0.015)

Variable	Model 1	Model 2	Model 3	Model 4
Low_income_adequacy	0.022*** (0.008)	0.022** (0.008)	0.020** (0.008)	0.016** (0.008)
Low_education_PMK	0.030*** (0.007)	0.023*** (0.007)	0.018** (0.007)	0.011 (0.007)
Urban	-0.001 (0.006)	-0.004 (0.006)	-0.010 (0.006)	-0.011 (0.006)
Exposure_to_violence		0.133*** (0.013)	0.084*** (0.013)	0.074*** (0.013)
Conflict_between_parents		0.113*** (0.022)	0.068*** (0.022)	0.050** (0.021)
Parental_smoking		0.036*** (0.006)	0.025*** (0.006)	0.020*** (0.006)
Parental_alcohol use		0.001 (0.006)	0.001 (0.006)	0.001 (0.006)
Parental_Depression (score of 9 and above)			0.033*** (0.007)	0.027*** (0.007)
Family_dysfunction (score of 15 and above)			0.026** (0.011)	0.021** (0.010)
Yell at child			0.063*** (0.007)	0.051*** (0.006)
Hostile ineffective parenting			0.013*** (0.000)	0.010*** (0.000)
Inconsistent parenting			0.003*** (0.000)	0.002 (0.000)
Negative interaction			-0.001 (0.001)	-0.001 (0.001)

Variable	Model 1	Model 2	Model 3	Model 4
Physical punishment			0.145*** (0.031)	0.133*** (0.030)
ADHD Score				0.209*** (0.008)

Notes: Standard errors are in parentheses. Coefficients that are statically significant appear in boldface.

*** Significance at the 1% level

**Significance at the 5% level

*Significance at the 10% level

Table 12 Odds Ratio for Childhood-onset CD (4-10 years): Cycle 1

Variable	Model1	Model 2	Model 3	Model 4
male	1.64*** (0.093)	1.58*** (0.091)	1.46*** (0.088)	1.26*** (0.078)
Mothers age group (15-24)				
25-29	0.76*** (0.050)	0.80*** (0.053)	0.82*** (0.057)	0.83** (0.060)
30-34	0.63*** (0.051)	0.67*** (0.055)	0.72*** (0.062)	0.73*** (0.065)
35-39	0.50*** (0.074)	0.55*** (0.082)	0.58*** (0.090)	0.61*** (0.096)
40+	0.58 (0.199)	0.65 (0.22)	0.79 (0.279)	0.74 (0.270)
Ethnicity Caucasian				
Ethnicity Asian	0.43** (0.159)	0.45** (0.168)	0.54 (0.210)	0.50* (0.202)
Ethnicity Black	0.73 (0.231)	0.77 (0.246)	0.78 (0.254)	0.82 (0.276)
Ethnicity Aboriginal	1.65*** (0.175)	1.53*** (0.166)	1.39*** (0.159)	1.29** (0.154)
Ethnicity Others	0.99 (0.083)	0.98 (0.083)	0.957 (0.085)	0.96 (0.088)
Single_parents_orphans	1.64*** (0.129)	1.83*** (0.157)	1.52*** (0.139)	1.39*** (0.131)

Variable	Model1	Model 2	Model 3	Model 4
4				
5	0.84 (0.084)	0.83 (0.08)	0.872 (0.091)	0.911 (0.098)
6	0.76*** (0.077)	0.75*** (0.076)	0.80** (0.086)	0.840 (0.092)
7	0.73*** (0.075)	0.71*** (0.073)	0.78** (0.087)	0.77** (0.089)
8	0.78** (0.079)	0.74*** (0.075)	0.83** (0.092)	0.82* (0.094)
9	0.68*** (0.071)	0.64*** (0.068)	0.71*** (0.082)	0.74** (0.088)
10	0.93 (0.091)	0.85 (0.084)	1.00 (0.11)	1.06 (0.120)
Province (NL)				
PEI	1.82*** (0.376)	1.77*** (0.369)	1.80*** (0.390)	1.71** (0.382)
NS	1.81*** (0.320)	1.77*** (0.315)	1.66*** (0.311)	1.62** (0.310)
NB	1.85*** (0.333)	1.86*** (0.336)	1.89*** (0.361)	1.85*** (0.361)
QC	2.31*** (0.361)	2.32*** (0.363)	2.49*** (0.409)	2.15*** (0.362)
ON	2.02*** (0.311)	1.95*** (0.302)	1.88*** (0.306)	1.91*** (0.319)
MB	1.59*** (0.283)	1.62*** (0.290)	1.56** (0.293)	1.57** (0.302)
SK	1.52** (0.268)	1.47** (0.260)	1.42* (0.266)	1.44* (0.276)
AL	1.56** (0.272)	1.57*** (0.275)	1.67*** (0.306)	1.68*** (0.315)
BC	1.84*** (0.321)	1.78*** (0.314)	1.77*** (0.327)	1.78*** (0.338)
Low_income_adequacy	1.19** (0.089)	1.19** (0.090)	1.19** (0.094)	1.18** (0.095)
Low_education_PMK	1.29*** (0.083)	1.22*** (0.079)	1.16** (0.080)	1.09 (0.078)

Variable	Model 1	Model 2	Model 3	Model 4
Urban	0.967 (0.061)	0.94 (0.060)	0.88 (0.059)	0.88 (0.060)
Exposure_to_violence		2.35*** (0.231)	1.63*** (0.173)	1.60*** (0.175)
Conflict_between_parents		2.02*** (0.327)	1.43** (0.250)	1.31 (0.237)
Parental_smoking		1.45*** (0.095)	1.32*** (0.091)	1.27*** (0.089)
Parental_alcohol_use		1.00 (0.061)	0.97 (0.062)	0.98 (0.063)
Maternal Depression (score of 9 and above)			1.25*** (0.090)	1.24*** (0.091)
Family dysfunction (score of 15 and above)			1.19* (0.114)	1.18* (0.112)
Yell at child			1.58*** (0.104)	1.55*** (0.104)
Hostile ineffective parenting			1.14*** (0.009)	1.09*** (0.010)
Inconsistent parenting			1.02*** (0.008)	1.02** (0.009)
Negative interaction			0.985 (0.010)	0.99 (0.011)
Physical punishment			2.02*** (0.469)	2.05** (0.499)
ADHD (score of 9 and above)				3.62*** (0.248)

Notes: Standard errors are in parentheses. Odds ratio that are statically significant appear in boldface.

*** Significance at the 1% level

**Significance at the 5% level

*Significance at the 10% level

Regression Results

The main aim of this research is to explore correlations between childhood-onset CD and the independent variables and the results do not imply causality. Results from Model 3 are discussed here, as model 3 is controlling for many covariates and reflects the actual relationship between childhood-onset CD and independent variables under study.

Male

Being a boy was associated with increase in the probability of childhood-onset CD by 3.6 percentage points (pp). The odds of boys developing childhood-onset CD was 1.46 times greater than girls. Even after controlling for negative parenting, stressful family environment (depression and family functioning) and ADHD, the coefficient and odds ratio on male remained statistically highly significant ($P < 0.01$) across all models. However, after including ADHD there is a dramatic drop in the male coefficient, and although the coefficient is still statistically significant, the coefficient on male is less than half indicating that a large part of the relationship between childhood-onset CD and being a boy appears to come from children who have comorbid ADHD. Similar significant results were obtained for Cycle 3 for this variable.

Mother's age at the birth of the child

Children born to very young mothers in the age group of 15-24 years, were more likely to have childhood-onset CD when compared to mothers in older age groups. Being born to mothers in the age group of 25-29 years, 30-34 years and 35-39 years was

associated with decrease in the probability of childhood-onset CD by 2.3 pp, 3.2 pp and 4.8 pp respectively. Similarly, the odds of childhood-onset CD decreased by 0.82 times, 0.72 times and 0.58 times respectively. The results for age group 40+ were not statistically significant in both the LPM and logistic regression. In Cycle 3 also similar results were obtained.

Low income & low education

Low family income and low parental education was associated with increase in probability of childhood-onset CD by 2 pp and 1.8 pp respectively. Similarly, the odds of having childhood-onset CD was higher in families with low income (1.19 times) and low education (1.16 times) with very little change across models. Even after controlling for stressful family environment and negative parenting these variables remained statistically significant. However, low education ceased to be significant after ADHD was added to the model. Similar results were obtained in Cycle 3 for these variables.

Single-parent households

Living in single-parent households was associated with increase in probability of childhood-onset CD by 7.1 pp and had an odds ratio of 1.5. Even after controlling for ADHD this variable stayed highly significant ($P < 0.01$) in Cycle 1. However, part of the relationship between single-parent households and childhood-onset CD appears to come from children with ADHD, as the coefficient on single-parent households is cut in half after including ADHD. In Cycle 3 living in single-parent families was found to be not associated with childhood-onset CD after controlling for stressful family environment like maternal depression, family dysfunction and ineffective parenting.

Exposure to violence, conflict between parents & parental smoking

The coefficients on exposure to violence was quite large and highly statistically significant ($P < 0.01$). The probability of childhood-onset CD increased by 8.4 pp in children who were exposed to violence at home and the odds of childhood-onset CD was 1.63 times higher for such children. Even after controlling for ADHD this variable remained significant. In Cycle 3 similar results were obtained.

There is strong evidence to suggest that there appears to be real association between childhood-onset CD and conflict between parents. Children who experience conflict between parents have more than double the odds of developing childhood-onset CD (1.43) than children who never experience conflict between parents. The probability of childhood-onset CD for such children was associated with an increase of 6.8 pp. This variable remained statistically significant across all the models in LPM in Cycle 1. However, the odds ratio ceased to be statistically significant after controlling for ADHD. In Cycle 3 similar results were obtained for this variable.

The coefficient on parental smoking was positive and highly statistically significant ($P < 0.01$), suggesting that it was associated with an increase in the probability of childhood-onset CD by 2.5 pp and the odds of childhood-onset was 1.32 times greater for children whose parents smoked. It remained highly significant even after controlling for other individual and family factors in all the models. Parental smoking was found to be highly significant in Cycle 3 even after controlling for all the covariates.

Alcohol consumption & Urban

In this study alcohol consumption and living in an urban area was found not to be associated with childhood-onset CD. The coefficients and odds ratio on both these variables were not statistically significant.

Maternal depression

Maternal depression increased the odds of childhood-onset CD by 1.25 times and the probability by 3.3 pp. The odds ratio for depression remained significant even after controlling for ADHD in Cycle 1. In Cycle 3 depression was found to be significantly associated with childhood-onset CD as well.

Family dysfunction

Family dysfunction was associated with increase in the probability of childhood-onset CD by 2.6 pp ($P < 0.05$) and had an odds ratio of 1.19 ($P < 0.1$) after controlling for sociodemographic factors and stressful family environment. Even after controlling for ADHD, this variable was significant. In Cycle 3 also, living in a dysfunctional family was significantly associated with childhood-onset CD. However, the odds ratio was insignificant after controlling for ADHD.

Physical punishment

There is strong evidence to suggest that when a child is often physically punished, the odds of having childhood-onset was 2.02 times and it was associated with increased probability of childhood-onset CD by 14.5 pp. This variable remained statistically significant even after controlling for ADHD. However, this variable was not found to be

a significant factor in Cycle 3 after taking controlling for sociodemographic factors and stressful family environment like family dysfunction and maternal depression.

Yelling at the child

Results revealed that often yelling at the child was strongly associated with childhood-onset CD. The odds ratio of developing childhood-onset CD was 1.58 times more for a child who was often yelled at, when compared to a child who was yelled at less frequently or never. Similarly, yelling was associated with increased probability of childhood-onset CD by 6.3 pp. This variable remained statistically significant even after controlling for ADHD. In Cycle 3 yelling often at a child was significantly associated with childhood-onset CD as well.

Hostile/ineffective parenting

A unit increase in hostile ineffective parenting score was associated with increased probability of childhood-onset CD by 1.3 pp in Cycle 1. The odds of childhood-onset CD was 1.1 times greater for a child whose parents used hostile parenting techniques (such as getting angry or annoyed at the child, focusing on negative rather than positive child behaviors) as compared to those whose parents used these parenting styles less often. Even after including ADHD, hostile-ineffective parenting variable stayed highly significant ($P < 0.01$) with very little change across the models. In Cycle 3 hostile ineffective parenting was also found to be strongly associated with childhood-onset CD.

ADHD

Presence of ADHD was entered last, and added significantly to the model; children with comorbid ADHD were 3.62 times more likely to have childhood-onset CD than those children without ADHD in Cycle 1. The probability of childhood-onset CD for such children increased by 21 pp. Similarly, presence of ADHD in Cycle 3 was strongly associated with childhood-onset CD. Both the Cycles show that ADHD was a highly significant ($p < 0.01$) variable.

Discussion and Conclusion

The comprehensive review of the research on childhood-onset CD reveals that there are several risk factors that have been associated with this disorder. Thus, in this thesis several risk factors were included in the analysis to find their association with childhood-onset CD in the Canadian population.

Individual and Family risk factors

This study was undertaken to test the hypothesis that individual and family risk factors such as: being a male; comorbidity with ADHD; low family income; low parental education; maternal depression; negative/ineffective parenting; family dysfunction; single-parent households; mother being very young at the birth of the child; physical punishment; conflict between parents; parental smoking; and exposure to violence are significant risk factors for childhood-onset of CD. The results revealed that there is strong evidence to suggest an association between childhood-onset CD and all these factors in Cycle 1 and Cycle 3 as well.

Individual risk factors

Male

The results across all models confirm that boys are more likely to have childhood-onset CD than girls. This could be since girls are more highly monitored than boys (Findlay, Garner, & Kohen, 2013). In addition, the difference between genders has been explained in terms of childhood reinforcement of aggressive behavior, where parents are more likely to reinforce girls for pro-social behavior than boys (Synder et al., 2003).

The descriptive analysis revealed that 15% of boys and 10% of girls had childhood-onset CD in Canada in Cycle 1. In Cycle 3, around 13% of boys and 9.5% of girls have childhood-onset CD. The results are in line with another study which estimated that around 6%–16% of boys and 2%–9% of girls meet the diagnostic criteria of CD (Searight, Rottnek & Abby, 2001). The regression analysis reveals that being a boy increases the odds of childhood-onset CD by 1.6 times than girls. This result is consistent with the accepted ideas about childhood-onset CD which state that “males predominate for child-onset and adolescent-onset CD, but this disparity lessens for adolescent-onset problems” (Zahn-Waxler, Shirtcliff & Marceau, 2008). Being a boy was significant in Cycle 3 as well.

ADHD

It is reported that ADHD is present in approximately one-third to one-half of the CD population and symptoms typically precede CD (Frick & Nigg, 2012; Stalk, Love & Mueller, 2015). Our results confirmed this finding for the Canadian population — approximately 33% and 37% of children with childhood-onset CD have ADHD in Cycle 1 and Cycle 3 respectively. On the NLSCY’s hyperactivity-inattention scale children with childhood-onset CD have a higher score of 7.6 compared to a score of 4.2 for no-CD children in both Cycle 1 and Cycle 3. The odds of childhood-onset CD increase by 3.62 times for children who meet the comorbid diagnosis of ADHD, even after controlling for sociodemographic factors and negative parenting practices in Cycle 1. In Cycle 3, this significant association was confirmed.

In the literature, the combined presentation of CD with ADHD is so robust that some experts opine it should be conceptualized as a subgroup within the greater CD population (Stalk, Love & Mueller, 2015). Especially when ADHD is associated with earlier age of CD onset, greater is severity of CD problems (Frick & Nigg, 2012; Stalk, Love & Mueller, 2015). Thus, while designing intervention and prevention strategies in Canada, children with comorbid ADHD diagnosis should be given priority.

Family risk factors

Part of the hypothesis tested in this study was that family risk factors such as: low family income, low parental education, maternal depression, negative/ineffective parenting, family dysfunction, single-parent households; mother being very young at the birth of the child; physical punishment; conflict between parents; parental smoking and exposure to violence are significant risk factors for childhood-onset of CD. Results reveal that there is strong evidence to suggest an association between childhood-onset CD and most of these factors in Cycle 1. However, in Cycle 3 single-parent households and physical punishment are not significantly associated with childhood-onset CD. The rest of the family risk factors are confirmed in Cycle 3 as well.

Harsh-ineffective parenting

A study using the NLSCY sample found that hostile-ineffective parenting increased the chance of occurrence of CD by five times (Landy & Tam, 1996). Consistent with previous studies hostile-ineffective parenting is found to be highly associated with childhood-onset CD in this study. Children with childhood-onset CD experienced, on average, a higher score for hostile-ineffective parenting (11.8 compared to 8.4 for no-CD

children). This variable stayed highly significant across the model and did not change much even after controlling for ADHD in both Cycle 1 and Cycle 3.

These results which show strong statistical correlations between negative parenting and childhood-onset do not infer causation. In the literature, “the relationship between parenting and child behavior has been shown to be highly reciprocal, in that poor parenting seems to be related to the onset of conduct disorder, and children with behavior problems appear to elicit poor parenting” (McCabe et al., 2001).

While our results do not demonstrate a causal link between negative parenting and childhood-onset CD, they are consistent with earlier research which have proposed that such harsh parenting practices may lead to increased conduct problems among children. Thus, although poor parenting is just one of several complex and contextual problems for conduct problems (Furlong et al., 2013), there is growing evidence that an improvement in parenting skills can reduce problematic child behaviors and increase child’s positive social and compliant behaviors (Reid, Patterson & Synder, 2002; Hutchings, Bywater, & Daley, 2007).

Physical punishment

In this study, use of physical punishment was found to be highly associated with childhood-onset CD. In Cycle 3, physical punishment is not significantly associated after controlling for sociodemographic factors and negative family environment. However, there is a trend of higher levels of childhood-onset CD in children who are often physically punished (25%), when compared to children who are never or sometimes physically punished (11%) in Cycle 3.

Although an increasing number of countries have prohibited physical/corporal punishment, the US and Canada are yet to achieve a full prohibition within certain settings like home, alternative care and daycare (“Global initiative to end the corporal punishment of children,” 2017). Out of many negative outcomes, physical punishment has also been associated with negative behavioral effects like increased aggression in children (Milne, 2015).

Research has revealed that there appear to be reciprocal influences of physical punishment (spanking) and child behavior (Maguire-Jack, Gromoske, & Berger, 2012). For instance, there is consistently higher rates of self-reported spanking among parents who report their child’s behavior is problematic than parents who do not report their child’s behavior as problematic (Maguire-Jack, Gromoske, & Berger, 2012). However, the influence of physical punishment on behavior problems appears to be stronger than that of behavior problems on physical punishment and it is being suggested that physical punishment may not be an effective way to discourage problematic behaviors. (Maguire-Jack et al., 2012).

Maternal depression

Research has found maternal depression to be a risk factor in the development of externalizing disorders like CD (Kim-Cohen et al., 2005). In the current study, maternal depression is found to be significantly associated with childhood-onset CD. Childhood-onset population score is higher on the maternal depression scale when compared to children without CD (6.6 vs. 4.5).

In the NLSCY indications of depressive tendencies in a parent have been found to be associated with hostile-ineffective parenting (Adams & Ryan, 2000) which is consistent with previous studies showing a relation between maternal depression and poor parenting (Shay & Knutson, 2008). In addition, research has also revealed that there is a higher incidence of withdrawal from their children among depressed parents (“Identification of vulnerable children”, n.d.) which may also lead to the development of CD (Shay, 2009). Thus, to reduce the risk of CD it is recommended that depressed mothers should receive treatment for depression and should also receive parent training, as treating depression alone will not improve parenting (Shay, 2009).

Family dysfunction

In this study, dysfunctional family is found to be statistically significant and there is a trend of higher levels of childhood-onset CD in dysfunctional families (20%) when compared to functional families (12%) in Cycle 1. Even on the family functioning score, children with childhood-onset have a higher score of 9.3 compared to a 7.7 for children without childhood-onset CD.

A study using the NLSCY survey found that family dysfunction was associated with higher levels of hostile-ineffective parenting (Adams & Ryan, 2000). Thus, while designing intervention/prevention strategies for childhood-onset CD, parenting programmes should be prioritized.

Exposure to violence in home

Exposure to violence in home is found to be strongly associated with childhood-onset CD (OR: 1.63; $p < .01$). Exposure to violence stayed highly significant even after

controlling for ADHD. Cycle 3 confirmed a highly statistically significant result for this variable as well. The long-term consequences of witnessing violence in home and consequent aggressive child behavior is well documented in the research literature (Hotton, 2003; Weaver, Borkowski & Whitman, 2008).

Despite the bad outcomes for children who are exposed to violence, it is reported not all of these children will develop CD (Hotton, 2003). There are many other important individual and family factors in a child's environment, which can lessen or aggravate the negative effects of witnessing violence in home (Hotton, 2003). Our research also suggests that a child's individual and family factors play an important role in the development of childhood-onset CD and intervention programs that address only a single factor are unlikely to be successful for a large number of children.

Conflict between parents

There is a trend of higher levels of childhood-onset CD when the child experienced conflict between the parents in this study. About 27% of children with childhood-onset CD experienced conflict between parents in Cycle 1 and 37% in Cycle 3. Consistent with previous studies conflict between parents was found to be significantly associated with childhood-onset CD. In the literature conflict between parents is a strong predictor of externalizing disorders like CD (Matthews, 2011). It is reported that during years of 8 to 13 many children mimic the characteristics of their parents and when they see their mother or father yelling, they think it is acceptable behavior (Fitzgerald, 2005).

Parental smoking

Parental smoking (postnatal exposure) increases the odds of childhood-onset CD by 1.45 times. Although research has established a link between prenatal smoking and CD, the potential role of Environmental Tobacco Smoke (ETS) and its link to CD is much less known (INSERM, 2015). In 2015, researchers analyzed data on pre- and postnatal exposure to tobacco in the homes of 5,200 primary school children and found that exposure to ETS in the postnatal period, alone or in association with exposure during pregnancy, increases the risk of behavioral disorders in primary school children, particularly CD (INSERM, 2015).

It is being predicted that nicotine contained in tobacco smoke may have a neurotoxic effect on the brain (INSERM, 2015). This study confirms that parental smoking (postnatal exposure) is significantly associated with childhood-onset CD. In Cycle 3 also this strong association between childhood-onset CD and parental smoking is confirmed.

Family demographic factors

Among the socio-demographic variables tested in this model, low income, low parental education, single parent household and mother being very young at the birth of child are significantly associated with childhood-onset CD. Even after controlling for stressful family environment, negative parenting and ADHD, these variables remain statistically significant, except for low parental education in Cycle 1. Low parental education ceased to be significant after ADHD was added to the model, indicating that

children with ADHD are more likely to have childhood-onset CD regardless of parental education.

These results are consistent with previous literature. Children from low income households, children from single-parent households and children with less educated mothers are less highly monitored (Garner, Kohen & Findlay, 2011) and it is a well-established fact that, low levels of parental monitoring are associated with greater signs of conduct problems, aggression, and antisocial or delinquent behavior (Crouter, Bumpus, Davis, & McHale, 2005; Laird, Marrero, & Sentse, 2010).

Being born to very young mothers (15-24 years old) is significantly associated with childhood-onset CD in this study, which is consistent with literature (Wakschlag et al., 2000). It may be due to the social circumstances typically surrounding young mothers, such as low income, which in turn influence their children's development (Weaver, Borkowski & Whitman, 2008).

Cycle 3 confirmed these findings, except for single-parent households which was found to be not associated with childhood-onset CD after controlling for negative family environment (maternal depression and family dysfunction) and negative parenting practices.

Prevalence of childhood-onset CD

In addition to exploring the risk factors for childhood-onset CD in Canada, the goal of this research is to determine the prevalence of childhood-onset CD in Canada for the age group 4-10 years. The prevalence of childhood-onset CD in this study is 12.5% for Cycle 1 and 11.4 % for Cycle 3. Precise global prevalence rates of childhood-onset

CD are difficult to obtain. In the UK and the US, around 5% to 10% of children between 5 and 15 years of age are present with clinically significant conduct problems. Our estimates are slightly higher as we included only children aged 4-10 years, and according to research only half of the children with CD behaviors in middle childhood progress to show CD symptoms in adolescence (Rowe, 2002).

Prevalence of childhood-onset CD: Age

CD has no lower age limit and in a child younger than 10 years old, the repetitive presence of 1 of the 15 symptoms given by the DSM is sufficient for the diagnosis of CD (Bernstein, 2016). We are unaware of prior studies using the childhood-onset CD definition given by the DSM to establish prevalence rates of childhood-onset CD. Since the criteria for the diagnosis of CD vary widely, it is difficult to compare the prevalence rates obtained in this study with international estimates.

In Cycle 1 children aged 10 had the highest prevalence rate of 15% whereas in Cycle 3 the youngest children aged 4 and 5 had the highest prevalence rate (14%). In Cycle 3 as the children's age increased prevalence rates reduced, except for age 10. The prevalence rates for the 10 years' old was high in both Cycle 1 and Cycle 3, it is because they were asked three additional questions (1. Stayed out all night without permission? 2. Ever run away from home? 3. Skipped a day of school without permission?), which rest of the age groups were not asked.

Prevalence of childhood-onset CD: Provinces

In Cycle 1, Newfoundland has the lowest prevalence rates (8%) in Canada while Quebec has the highest prevalence rate of 15%. In Cycle 3 Newfoundland continued to

have the lowest prevalence rate (6%), while Saskatchewan has the highest prevalence rate of 14% (Appendix 5). New Brunswick, Ontario, British Columbia have similar prevalence rates in both the cycles. In Cycle 1 childhood-onset CD is more prevalent in the Central Canada whereas it is more prevalent in Western Canada in Cycle 3. We are unaware of any prior studies demonstrating a higher prevalence of childhood-onset CD in Central or Western Canada. The reason for higher prevalence rates in some provinces or lower prevalence rates in Newfoundland is unclear and should be examined in future studies.

Prevalence of childhood-onset CD: Symptoms

The top symptoms exhibited by childhood-onset population in Canada are: reacts with anger and fighting; gets into many fights; physically attacks people; threatens people; kicks, hits and bites; destroys own things; and lies and cheats. Most of the top symptoms displayed by the childhood-onset population are associated with the first CD criterion “Aggression against people and animals.” It is consistent with literature, which suggests that children who develop early-onset conduct disorder (before 10) are usually physically aggressive throughout childhood (ICEC, 2005). Most children begin to commit acts of physical aggression from a very young age with the frequency of such acts increasing around the age of 4 (ICEC, 2005).

The Childhood-onset population also displayed symptoms consistent with “Destruction of Property” (destroys own things) and “Deceitfulness of theft” (lies or cheats) which is consistent with literature. Acts related to “Destruction of property” begin

in early childhood and children identified with childhood-onset CD often lie or steal (ICEC, 2005).

Comparison with other NLSCY studies

A study on risk factors for CD in early adolescence (12-13 years) using the first three Cycles of the NLSCY found that being a male, living in non-intact family (mobile family), associating with deviant peers, experiencing coercive/ineffective parenting and hyperactivity/inattention was significantly associated with CD (Lacourse, 2012). The other risk factors such as neighborhood socioeconomic disadvantage, and family socioeconomic status were found to be not associated with CD. The study concluded by suggesting that resources could be devoted more to addressing individual- and familial-level risk factors — the outcome of this thesis also points to a similar suggestion for childhood-onset CD.

Another study using NLSCY Cycle 3 to explore risk factors for adolescent group (10-15 years) found being a male, low SES, presence of a stepparent in a two-parent family, negative parenting style, parents hitting or threatening a child and living in a dysfunctional family to be significantly associated with CD (Tervo, 2005). Single-parent households and maternal depression were not significant factors for CD in this study.

Some of the common risk factors for both childhood-onset group and adolescent group appears to be being a male and negative parenting in Canada. An important risk factor for the adolescent group appear to be association with deviant peers, which explains why some children with no childhood behavioral problems suddenly engage in antisocial behavior in adolescence (Lacourse, 2012).

The major risk factors for childhood-onset CD that emerge for the Canadian population from this study are: being a male; comorbidity with ADHD; low income; maternal depression; family dysfunction; hostile-ineffective parenting; yelling at a child often; exposure to violence in home; parental smoking; and mother being very young at the birth of the child.

Summary & Recommendations

The wide range of risk factors associated with CD implies that is very unlikely that a single risk factor will adequately account for the development of CD. Prevention programs that address only a single factor are unlikely to be successful for a large number of children (Frick, 2004). This research has integrated multiple factors in trying to explain the development of childhood-onset CD in Canada which could be useful for policymakers to design effective prevention /intervention policies. The results of this study will be also useful for educators, school social workers and researchers by providing a clear picture of the individual and family risk factors for childhood-onset CD in Canada.

Although early-starters were earlier not viewed as individuals who could indulge in serious forms of antisocial behavior before the age of 10 years (Shaw, 2013), research in the last three decades has documented that a subset of early-starters youth can be identified as early as around 3 years of age. (Campbell, Pierce, March, Ewing, & Szumowski, 1994; Moffitt, 1993; Richman, Stevenson, & Graham, 1982; Shaw, Hyde & Brennan, 2012). Childhood-onset CD is associated with broad impairment that may or may not disappear as children grow to adulthood. It is estimated that prevention of a

single case of CD saves CAD1.7 million in cumulative lifetime costs (Lipman & Boyle, 2008). It is, therefore, very important to design targeted prevention strategies aimed at children at risk of developing childhood-onset CD.

Some of the child behaviors are hard to change after they have become embedded. Research evidence shows that prevention should be a priority and prevention programs targeting high-risk groups should start early (Waddell et al., 2004). It is reported that prevention and intervention studies “initiated prior to school entry have shown greater efficacy for treating children with clinically-elevated rates of conduct problems than for older children” (Shaw, 2013, p. 419).

A systematic review of prevention studies show that targeted approaches to improving parenting in high-risk families with young children seems to be the most promising (Waddell et al., 2004). The characteristics of most effective prevention programs are: they start early, in some cases by prenatal period; they target high-risk families; and they acknowledge that CD arises within a social context and it is imperative to intervene at the family and community levels, not just at individual level (Waddell et al., 2004).

Strengths

The current study has some important strengths. The weighted and nationally representative survey like NLSCY allows examination of childhood-onset CD risk factors from an individual and family environment perspective which has not been examined in Canadian population for this age group. A large survey like NLSCY increases the generalizability of the findings. To further strengthen the generalizability of this research

and to ensure the results are robust Cycle 3 was included in the analysis for replication. This study is an improvement upon previous studies by including a large population of children who met DSM-5 criteria for the diagnosis of childhood-onset CD and by incorporating a large number of risk factors compared to other studies.

Limitations & future research

There are several limitations to this study. The NLSCY was not designed to directly estimate the number of children with childhood-onset CD but was intended to measure a variety of family, peer, school and neighborhood influences on children. Moreover, responses to questions on CD symptoms were given by parents who may underreport or in some rare cases over report frequency and number of CD symptoms. This study recorded childhood-onset CD as present based on the parent report alone, which is conservative when compared with studies that confirmed a diagnosis as present if both the child and parent together endorsed the symptoms (McCabe et al., 2001). Finally, similar to all other non-experimental studies, omitted variable bias is a potential problem, even if many individual and family risk factors were included in the analyses.

Future studies should replicate the findings of this study in longitudinal analysis for the Canadian population. A longitudinal analysis could test the developmental taxonomy that distinguishes between childhood-onset and adolescent-onset CD; how these children differ on the risk factors. Future research can also study the applicability of ‘cumulative risk approach’ in Canadian population, where severe CD behavior in adolescence/ adulthood is a function of the number of risk factors present, with risk increasing in a linear manner from the presence of no risk factors to the presence of six or

more risk factors. There is a need to further investigate, if the risk factors differ for children who are aggressive than children who indulge in non-aggressive CD behaviors like theft or violation of rules. It is being suggested that the form of CD behavior that a child displays in childhood (aggressive vs. non-aggressive) may be more important in determining persistence of CD in adolescence and adulthood rather than age-of-onset of CD (Fairchild, Van, Calder & Goodyer, 2013).

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Appendix

Results from NLSCY Cycle 3

Table A1 Prevalence of Childhood-onset CD by Age (4-10 years): Cycle 3

Age (yrs)	Total population	No childhood-onset CD population	Childhood-onset CD population	Prevalence of childhood-onset CD (in %)
4	394,330	340,274	54,056	14%
5	389,014	334,694	54,320	14%
6	411,989	358,485	53,504	13%
7	357,001	316,114	40,887	11%
8	476,646	435,506	41,140	9%
9	351,926	319,233	32,693	9%
10	460,055	411,660	48,395	11%
Total	2,840,961	2,515,966	324,995	11.4%

Table A2 Prevalence of Childhood-onset CD by Province (4-10 years): Cycle 3

Province	Total population	No childhood-onset CD population	Childhood-onset CD population	Prevalence of childhood-onset CD (in %)
NL	45,657	42,937	2,720	6%
PEI	13,115	12,030	1,085	8%
NS	85,204	75,220	9,984	12%
NB	65,440	57,727	7,713	12%
QC	655,182	581,173	74,009	11%
ON	1,095,730	964,159	131,571	12%
MB	116,008	104,398	11,610	10%
SK	108,637	93,749	14,888	14%
AL	300,659	268,330	32,329	11%
BC	355,329	316,243	39,086	11%
Canada	2,840,961	2,515,966	324,995	11.4%

Table A3 Top Five Childhood-onset CD symptoms in Canada (4-10 years): Cycle 3

Rank	Symptom	Frequency	Percent
1	Reacts with anger & Fighting	156,993	5.5%
2	Gets into many fights	109,646	3.8%
3	Lies and cheats	63,770	2.2%
4	Destroys own things	62,218	2.1%
5	Physically attacks people	26,608	1.0%
5	Steals at home	25,414	1.0%

Table A4 Mean and Standard Deviation of Dichotomous Variables (4-10 years): Cycle 3

Description	Detail	Total Sample population	Childhood-onset population	Mean	Std. Dev
Gender	1=boys	1,456,437	193,044	0.132	0.339
	0=girls	1,384,524	131,951	0.095	0.293
Ethnicity	Caucasian	2,494,165	288,250	0.115	0.319
	Asian	85,415	8,759	0.102	0.303
	Black	41,362	4,861	0.117	0.322
	Aboriginals				
		122,335	18,274	0.149	0.356
	Others	532,916	57,594	0.108	0.310
Single Parents/Orphans	1=single parent/orphans	523,419	71,243	0.136	0.342
	0=two parent households	2,317,542	253,752	0.109	0.312
Low parental education	1=less than high school	373,118	57,445	0.153	0.36
	0=more than high school	2,467,843	267,550	0.108	0.31
Low income Adequacy	1=low income	374,865	51,822	0.138	0.345
	0=middle/high income	2,466,096	273,173	0.11	0.313

Description	Detail	Total Sample population	Childhood-onset population	Mean	Std. Dev
Mothers age group	15-24 yrs.	2,205,962	550,013	0.148	0.355
	25-29 yrs.	1,777,926	978,049	0.113	0.3169
	30-34 yrs.	1,887,084	868,891	0.108	0.31
	35-39 yrs.	2,455,801	300,174	0.076	0.265
	40+ yrs.	2,697,127	58,848	0.09	0.287
Urban/Rural	1=urban	2,463,465	284,568	0.115	0.319
	0=rural	377,496	40,427	0.107	0.309
Poor neighborhood	1=yes	63,927	14,156	0.221	0.415
	0=no	2,710,178	304,626	0.112	0.315
Parental smoking	1=yes	700,450	101,249	0.144	0.351
	0=no	2,039,994	214,362	0.105	0.306
Parental alcohol use	1=yes	1,267,360	144,060	0.113	0.317
	0=no	1,573,601	180,935	0.114	0.3189
Exposure to violence in home	1=yes	121,424	32,782	0.269	0.443
	0=no	2,719,537	292,213	0.107	0.309
Family Dysfunction	1=family functioning score of 15 and above	223,164	52,993	0.237	0.425
	0= family functioning score of 14 and below	2,617,797	272,002	0.103	0.305
Maternal Depression	1= depression score of 9 above	462,327	91,498	0.197	0.398
	0= depression score of 8 and below	2,378,634	233,497	0.098	0.297
Yell at child	1=yes	500,794	127,563	0.254	0.435
	0=no	2,340,167	197,432	0.084	0.277
Abuse	1=yes	11,136	2,895	0.259	0.438
	0=no	2,829,825	322,100	0.113	0.317
Physical punishment	1=yes	7,687	1,917	0.249	0.432
	0=no	2,833,274	323,078	0.114	0.317

Description	Detail	Total Sample population	Childhood-onset population	Mean	Std. Dev
Conflict between parents	1=yes	33,582	12,513	0.372	0.483
	0=no	2,807,379	312,482	0.111	0.314
ADHD	1=Hyperactivity/inattention score of 9 and above	375,987	133,943	0.356	0.478
	0=H/I score of 8 and below	2,464,974	191,052	0.077	0.267

* Means of the childhood-onset CD population for the risk factors are given in bold.

Table A5 Mean and Standard Deviation of Continuous Variables (4-10 years): Cycle 3

Score	Total Sample Population	Mean	Standard Deviation
SES Score (-2.0 to +1.75)			
Childhood-onset CD	322,159	-0.200	0.723
No childhood-onset CD	2,494,339	-0.057	0.733
Depression Score (0 to 36)			
Childhood-onset CD	317,545	6.74	6.34
No childhood-onset CD	2,427,786	4.32	5.17
Family Functioning score (0 to 36)			
Childhood-onset CD	314,271	9.79	5.27
No childhood-onset CD	2,417,422	8.25	5.02
Hyperactivity-Inattention score (ADHD) (0 to 16)			
Childhood-onset CD	322,278	7.61	4.29
No childhood-onset CD	2,342,828	4.22	3.27
Hostile Ineffective Parenting score (0 to 25)			
Childhood-onset CD	319,011	12.02	4.07
No childhood-onset CD	2,325,625	8.37	3.29
Negative Interaction score (reverse coded to represent less positive interactions) (0 to 20)			
Childhood-onset CD	320,538	7.68	3.06
No childhood-onset CD	2,345,910	7.04	2.77
Inconsistent (reverse coded to represent inconsistency in parenting) (0 to 20)			
Childhood-onset CD	319,051	5.93	3.46
No childhood-onset CD	2,322,788	4.81	3.12

*Means of the childhood-onset CD population are given in bold.

Table A6 Linear Probability Model for Childhood-onset CD: NLSCY Cycle 3

Variable	Model 1	Model 2	Model 3	Model 4
male	0.052*** (0.005)	0.049*** (0.005)	0.035*** (0.005)	0.026*** (0.005)
Mothers age group (15-24)				
25-29	-0.030*** (0.007)	-0.027*** (0.007)	-0.022*** (0.007)	-0.018*** (0.007)
30-34	-0.042*** (0.007)	-0.038*** (0.007)	-0.029*** (0.007)	-0.023*** (0.007)
35-39	-0.058*** (0.010)	-0.052*** (0.010)	-0.033*** (0.010)	-0.029*** (0.010)
40+	-0.035 (0.023)	-0.050** (0.024)	-0.033 (0.023)	-0.030 (0.023)
Ethnicity_Caucasian				
Ethnicity_Asian	-0.012 (0.018)	-0.007 (0.019)	-0.010 (0.019)	-0.009 (0.018)
Ethnicity_Black	-0.019 (0.026)	-0.011 (0.027)	-0.012 (0.028)	-0.016 (0.027)
Ethnicity_Aboriginal	0.042*** (0.012)	0.035*** (0.012)	0.030** (0.012)	0.025** (0.012)
Ethnicity_Others	-0.003 (0.007)	-0.004 (0.007)	-0.000 (0.007)	-0.000 (0.009)
single_parents_orphans	0.015* (0.009)	0.023*** (0.009)	0.009 (0.009)	0.003 (0.009)
Age (4)				
5	-0.009 (0.008)	-0.011 (0.008)	-0.003 (0.008)	-0.001 (0.008)
6	-0.028*** (0.011)	-0.031*** (0.011)	-0.030*** (0.011)	-0.028*** (0.010)
7	-0.035*** (0.012)	-0.037*** (0.012)	-0.037*** (0.012)	-0.040*** (0.012)
8	-0.040*** (0.011)	-0.041*** (0.011)	-0.041*** (0.011)	-0.043*** (0.011)

Variable	Model 1	Model 2	Model 3	Model 4
9	-0.047*** (0.013)	-0.053*** (0.013)	-0.042*** (0.013)	-0.045*** (0.011)
10	-0.040*** (0.011)	-0.048*** (0.012)	-0.0435*** (0.012)	0.046*** (0.012)
Province (NL)				
PEI	0.036* (0.020)	0.033* (0.020)	0.006 (0.019)	0.007 (0.019)
NS	0.058*** (0.017)	0.054*** (0.017)	0.016 (0.016)	0.015 (0.016)
NB	0.067*** (0.017)	0.066*** (0.017)	0.047*** (0.016)	0.046*** (0.016)
QC	0.073*** (0.014)	0.074*** (0.014)	0.057*** (0.014)	0.050*** (0.013)
ON	0.072*** (0.014)	0.070*** (0.014)	0.031** (0.013)	0.028** (0.013)
MB	0.089*** (0.016)	0.069*** (0.017)	0.025 (0.016)	0.024 (0.016)
SK	0.037** (0.016)	0.086*** (0.016)	0.040** (0.016)	0.041** (0.016)
AL	0.079*** (0.015)	0.080*** (0.015)	0.044*** (0.015)	0.043*** (0.015)
BC	0.064*** (0.015)	0.063*** (0.016)	0.036** (0.015)	0.036** (0.015)
Low_income_adequacy	0.021** (0.008)	0.027*** (0.009)	0.027*** (0.009)	0.022** (0.009)
Low_education_PMK	0.026*** (0.007)	0.017** (0.008)	0.017** (0.008)	0.012 (0.008)
Urban	0.007 (0.057)	0.006 (0.007)	0.001 (0.006)	-0.011 (0.006)
Exposure_to_violence		0.164*** (0.014)	0.098*** (0.014)	0.086*** (0.014)
Conflict_between_parents		0.127*** (0.029)	0.071** (0.028)	0.065** (0.028)

Variable	Model 1	Model 2	Model 3	Model 4
Parental_smoking		0.033*** (0.006)	0.022*** (0.006)	0.017*** (0.006)
Parental_alcohol_use		0.007 (0.005)	-0.003 (0.005)	0.00 (0.005)
Parental_Depression (score of 9 and above)			0.039*** (0.007)	0.031** (0.007)
Family_dysfunction (score of 15 and above)			0.036*** (0.011)	0.028** (0.011)
Yell at child			0.047*** (0.007)	0.042*** (0.007)
Hostile ineffective parenting			0.023*** (0.000)	0.019*** (0.000)
Inconsistent parenting			0.001* (0.000)	0.001 (0.000)
Negative interaction			0.002* (0.001)	0.002** (0.001)
Physical punishment			0.063 (0.042)	0.070* (0.041)
ADHD Score				0.181*** (0.008)

Notes: Standard errors are in parentheses. Coefficients that are statically significant appear in boldface.

*** Significance at the 1% level

**Significance at the 5% level

*Significance at the 10% level

Table A7 Odds Ratio for Childhood-onset CD: NLSCY Cycle 3

Variable	Model 1	Model 2	Model 3	Model 4
male	1.67*** (0.087)	1.63*** (0.087)	1.51*** (0.087)	1.40*** (0.083)
Mothers age group (15-24)				
25-29	0.77*** (0.051)	0.78*** (0.053)	0.81*** (0.060)	0.83** (0.062)
30-34	0.67*** (0.048)	0.70*** (0.052)	0.74*** (0.059)	0.78*** (0.064)
35-39	0.57*** (0.062)	0.60*** (0.066)	0.69*** (0.082)	0.71*** (0.086)
40+	0.73 (0.171)	0.61* (0.160)	0.68 (0.190)	0.72 (0.203)
Ethnicity_Caucasian				
Ethnicity_Asian	0.88 (0.166)	0.93 (0.181)	0.86 (0.184)	0.84 (0.186)
Ethnicity_Black	0.83 (0.214)	0.89 (0.237)	0.85 (0.252)	0.81 (0.243)
Ethnicity_Aboriginal	1.37*** (0.143)	1.29** (0.138)	1.26** (0.150)	1.22* (0.148)
Ethnicity_Others	0.961 (0.071)	0.95 (0.073)	0.969 (0.080)	0.97 (0.081)
single_parents_orphans	1.13* (0.086)	1.24** (0.108)	1.09 (0.106)	1.04 (0.103)
Age (4)				
5	0.92 (0.070)	0.90 (0.07)	0.97 (0.081)	0.98 (0.083)
6	0.76** (0.081)	0.74*** (0.080)	0.73*** (0.086)	0.73*** (0.087)
7	0.71*** (0.087)	0.70*** (0.087)	0.66*** (0.089)	0.62*** (0.085)
8	0.67** (0.077)	0.66*** (0.077)	0.62*** (0.079)	0.59*** (0.077)

Variable	Model1	Model 2	Model 3	Model 4
9	0.62*** (0.083)	0.57*** (0.079)	0.57*** (0.086)	0.52*** (0.082)
10	0.67*** (0.080)	0.62*** (0.075)	0.59*** (0.080)	0.56*** (0.078)
Province (NL)				
PEI	1.65** (0.401)	1.60* (0.392)	1.35 (0.350)	1.32 (0.346)
NS	2.13*** (0.436)	2.07*** (0.427)	1.60** (0.350)	1.56** (0.345)
NB	2.35*** (0.482)	2.34*** (0.483)	2.17*** (0.476)	2.13*** (0.474)
QC	2.48*** (0.452)	2.53*** (0.464)	2.38*** (0.463)	2.20*** (0.433)
ON	2.48*** (0.449)	2.42*** (0.442)	1.83*** (0.356)	1.77*** (0.347)
MB	2.35*** (0.475)	2.39*** (0.487)	1.70*** (0.370)	1.64** (0.361)
SK	2.84*** (0.563)	2.79** (0.556)	1.95*** (0.416)	1.95*** (0.422)
AL	2.62*** (0.504)	2.67*** (0.517)	2.19*** (0.451)	2.12*** (0.441)
BC	2.28*** (0.446)	2.27*** (0.448)	1.95*** (0.410)	1.91*** (0.406)
Low_income_adequacy	1.20** (0.094)	1.27*** (0.107)	1.30*** (0.120)	1.24** (0.117)
Low_education_PMK	1.24*** (0.088)	1.14* (0.084)	1.15** (0.093)	1.12 (0.093)
Urban	1.07 (0.074)	1.05 (0.074)	1.01 (0.076)	1.01 (0.077)
Exposure_to_violence		2.86*** (0.306)	1.79*** (0.214)	1.71*** (0.211)
Conflict_between_parents		2.27*** (0.482)	1.59** (0.377)	1.55* (0.380)

Variable	Model1	Model 2	Model 3	Model 4
Parental_smoking		1.38*** (0.083)	1.25*** (0.081)	1.20*** (0.080)
Parental_alcohol_use		1.06 (0.063)	0.993 (0.063)	1.02 (0.066)
Parental_Depression (score of 9 and above)			1.33*** (0.097)	1.27*** (0.095)
Family_dysfunction (score of 15 and above)			1.20* (0.118)	1.16 (0.117)
Yell at child			1.32*** (0.089)	1.29*** (0.089)
Hostile ineffective parenting			1.24*** (0.011)	1.20*** (0.011)
Inconsistent parenting			1.01** (0.009)	1.01** (0.009)
Negative interaction			1.02** (0.011)	1.02** (0.011)
Physical punishment			1.30 (0.453)	1.42 (0.513)
ADHD (score of 9 and above)				2.9*** (0.200)

Notes: Standard errors are in parentheses. Odds ratio that are statically significant appear in boldface.

*** Significance at the 1% level

**Significance at the 5% level

*Significance at the 10% level

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