

Criminal Justice System Involvement among Children and Youth with Autism Spectrum

Disorder in Manitoba

by

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Abstract

Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that affects social communication and interaction and is often accompanied by restricted or repetitive behaviors. Earlier studies suggested that certain ASD-related behaviors may increase the likelihood of involvement in the criminal justice system (CJS), whereas more recent studies have reported contrasting findings. However, in Manitoba, Canada evidence is limited. This study had two objectives: (1) to compare ASD case-identification algorithms using administrative data available at the Manitoba Centre for Health Policy (MCHP) and identify the algorithm that best captures individuals with ASD, and (2) to examine age- and role-specific frequency and time to first criminal justice system involvement (CJSI) among individuals with ASD compared with matched controls in Manitoba, Canada.

Methods: Linked administrative data housed at the Manitoba Centre for Health Policy were used. Two ASD case-identification algorithms were compared: a restrictive algorithm requiring more ASD-related physician claims and a relaxed algorithm requiring fewer claims, while all other criteria remained the same. A retrospective matched cohort study was then conducted, matching everyone with ASD to three individuals without ASD on age, sex, and Regional Health Authority. Cox proportional hazards models were used to examine time to first CJSI, and zero-inflated negative binomial models were used to assess CJSI frequency.

Results: The restrictive algorithm yielded higher diagnostic certainty and positive predictive value, whereas the relaxed algorithm demonstrated higher sensitivity. Based on these findings, the restrictive algorithm was selected for the primary analyses. Individuals with ASD had a significantly lower risk of first CJSI and fewer CJS contacts than matched controls. This

association was consistent across involvement roles and age groups. Sensitivity analyses supported the robustness of the findings.

Conclusions: These findings highlight the importance of algorithm selection when identifying ASD using administrative data. In this Manitoba population, ASD was not associated with an increased risk of CJSI and was linked to lower overall involvement in the criminal justice system. Further research is needed to better understand discrepancies across studies and jurisdictions.

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With sincere gratitude,

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Dedication

To my husband, my parents, and my brother,

For your unconditional love, endless support, and for always believing in me.

***To every child and young person who deserves to be understood, supported, and given every
opportunity to thrive.***

Disclaimer

The data used in this study were obtained from the Manitoba Population Research Data Repository housed at the Manitoba Centre for Health Policy (MCHP), University of Manitoba, and were derived from information provided by the Rehabilitation Centre for Children, Immigration, Refugees and Citizenship Canada (IRCC), Manitoba Justice, Manitoba Education, and the Department of Families. The author acknowledges the Manitoba Centre for Health Policy for access to, and use of data contained within the Manitoba Population Research Data Repository under Project # 2025-043.

The results and conclusions presented in this thesis are those of the author and do not necessarily reflect the opinions or policies of the Manitoba Centre for Health Policy, Manitoba Health, or any of the data providers. No official endorsement by these organizations is intended or should be inferred.

Use of Artificial Intelligence

Generative artificial intelligence (AI) tools were used solely to improve the grammar, wording, and readability of portions of this thesis. All scientific content, analyses, interpretations, and conclusions are the author's own. The author reviewed and approved all AI-assisted revisions and accepts full responsibility for the final content of this thesis.

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Chapter 1. Introduction

1.1 Background

Autism Spectrum Disorder (ASD) affects how people communicate and interact with others and is often associated with restricted or repetitive behaviors (1). In recent years, increased public awareness and public health initiatives related to ASD have contributed to earlier detection and a rise in the reported prevalence of ASD worldwide (2). A recent three-level mixed-effects meta-analysis of global studies by Talantseva et al. found regional differences in ASD prevalence, with rates exceeding 1% in North America, compared with 0.73% in Europe and 0.41% in Asia (3). In Canada, national data indicate that ASD prevalence continues to increase. By 2019, approximately 2% of Canadian children and youth under 18 years of age had been diagnosed with ASD (4). In Manitoba, a population-based study by Hamad and colleagues found that ASD prevalence among children aged 1 to 5 years increased from 0.46% in 2004 to 0.97% in 2015 (5).

Researchers continue to debate whether autism-related characteristics are directly associated with offending behavior (6–9). Helverschou et al. reported that certain autism-related characteristics, such as social misunderstandings, intense interests, and atypical beliefs or behaviors, may contribute to offending in some cases. However, participants in their study more frequently identified stress as a key factor influencing their behavior (10).

1.2 ASD and Criminal Justice System Involvement

With the increasing prevalence of ASD worldwide, there has been growing evidence of interactions between autistic individuals and police, as well as several well-publicized cases of police violence involving autistic people in different countries (11,12). However, the evidence remains mixed regarding whether individuals with ASD are more or less likely to be involved in

the criminal justice system (CJS) than those without ASD. Some earlier studies reported higher rates of CJS involvement among individuals with ASD compared with those without ASD (13–16). More recent studies, however, have found similar or lower rates of offending among individuals with ASD relative to the general population (8,17–19).

A systematic review by King and Murphy, which examined research published up to January 2013, found that individuals with ASD were generally less likely to offend than people of the same age and sex. Although findings regarding offence types were mixed, offences against the person were reported more frequently than property offences (18).

Building on the work of King and Murphy, Collins et al. (17) conducted a systematic review examining patterns of contact with the criminal justice system among individuals with ASD. The authors concluded that a lack of high-quality, methodologically rigorous research limits the ability to draw firm conclusions. They also noted that when individuals with ASD are involved in offending, the reported cases span a wide range of offence types, including violent and sexual offences, arson, and stalking (17).

Similarly, a more recent review by Dell’Osso et al. (8) highlighted that existing studies often lack methodological rigor and produce inconsistent findings. The authors concluded that there is currently no clear evidence supporting a direct association between ASD or autistic traits and a predisposition to criminal behavior. They emphasized the need for further research to clarify this relationship (8).

A national birth cohort study conducted in New Zealand was the first to use linked administrative data to compare criminal justice system involvement (CJSI) among young adults with and without ASD (19). The study found that individuals with ASD were less likely to be proceeded against by

police, charged in court, or convicted in court than their non-autistic peers after adjusting for sociodemographic factors. However, the two groups had similar rates of incarceration. These findings are consistent with more recent research and contrast with those of earlier studies on this topic (19).

Bowden et al. also found that when young adults with ASD became involved in the justice system, they often faced a greater number of charges and were more likely to be charged with serious offences carrying potential prison sentences of two years or more. In terms of offence type, autistic youth were more frequently charged with offences against the person, violent offences, and property offences, whereas offences involving organizations, government bodies, or the wider community were less common (19).

While increasing attention has been paid to the criminalization of individuals with ASD, it is equally important to examine their experiences of victimization. A review by Sreckovic et al. found that children with ASD are more likely to experience bullying victimization than their typically developing peers (20).

Using the Juvenile Victimization Questionnaire (JVQ), Pfeffer et al. (2016) found that more than 80% of children with ASD experienced at least one form of victimization in the previous year, and 92% experienced multiple incidents. Assault and bullying were the most common forms of victimization, whereas sexual assault was the least common. Different forms of victimization frequently co-occurred, highlighting the high risk of victimization among children with ASD (21).

In a systematic review, Trundle et al. examined the prevalence of different forms of victimization among individuals with ASD, including bullying, sexual violence, and crime. Their findings indicated that approximately 44% of autistic individuals experienced some form of victimization.

Rates varied by type, including bullying (47%), child abuse (16%), sexual victimization (40%), cyberbullying (13%), and polyvictimization (84%) (22).

An Australian study found that autistic adults experienced higher rates of violence than non-autistic adults, including multiple forms of violence and repeated victimization (23). There is also limited understanding of the risk of sexual victimization among individuals with ASD. However, Brown-Lavoie et al. found that adults with ASD had lower levels of sexual knowledge and relied less on social learning. As a result, they may be at increased risk of sexual victimization, with this risk partly attributable to lower levels of sexual knowledge (24).

In a Canadian study, Weiss et al. (2018) found that childhood victimization was more common among individuals with ASD than among those without ASD. Much of this victimization occurred in peer contexts and included teasing and emotional bullying. Individuals with ASD also experienced higher rates of property victimization, maltreatment, and sexual victimization. These experiences often persisted into adulthood, with individuals with ASD continuing to report emotional bullying and sexual victimization as adults (25).

1.3 Limitations of Existing Evidence

Discrepancies in the literature regarding the involvement of individuals with ASD in the criminal justice system (CJS) are largely attributable to differences in study methodologies, small and potentially biased samples, and the absence of matched comparison groups without ASD, all of which limit the ability to draw reliable conclusions (10,17,18).

Administrative data can help address some of these limitations by enabling large, population-based studies of CJSI across different roles and age groups. However, these data capture only officially recorded events and may be influenced by reporting practices, levels of supervision, and access to

services. Consequently, careful study design and interpretation are required to ensure that findings are meaningful and not overgeneralized.

This study uses linked administrative data to address several of these methodological limitations while recognizing the inherent limitations of administrative health and justice records.

1.4 Thesis Objectives

Based on the limitations of existing literature, this thesis has two main objectives.

The first objective is to evaluate the accuracy of ASD case-identification algorithms using administrative data in Manitoba. This validation study compares ASD cases identified in administrative health and education datasets with clinically confirmed diagnoses from the Rehabilitation Centre for Children (RCC) and Children's disABILITY Services (CDS), which provide clinically and service-based ASD ascertainment for comparison. Two administrative algorithms are evaluated to assess their ability to identify ASD cases accurately.

The second objective is to compare CJSI between individuals with ASD and matched individuals without ASD in Manitoba. Using a population-based retrospective cohort design and linked administrative datasets, this study examines both time to first justice system contact and the number of justice system contacts. These outcomes are assessed across different life stages (childhood, youth, and adulthood) and justice system roles (accused, victim, and witness).

Overall, these objectives aim to improve the identification of ASD in administrative data and provide population-based evidence on CJSI among individuals with ASD in Manitoba.

1.5 Structure of the Thesis

This thesis is organized into five chapters.

Chapter 1 introduces the study and provides background information. It presents an overview of ASD, reviews the existing literature on CJSI among individuals with ASD, identifies key research gaps, and outlines the thesis objectives and structure.

Chapter 2 reviews the literature on ASD and CJSI across different justice system roles. It summarizes existing evidence and identifies gaps that this study aims to address.

Chapter 3 focuses on the first objective of the thesis: evaluating ASD case-identification algorithms using administrative data. It compares two administrative algorithms with clinically confirmed diagnoses and presents the methods, results, and discussion of the validation study.

Chapter 4 addresses the second objective by examining CJSI among individuals with ASD and matched controls. Using a population-based cohort design and linked administrative datasets, it examines time to first justice system contact and the number of justice system contacts across different life stages and justice system roles. The chapter presents the methods, results, and discussion of the cohort study.

Chapter 5 presents the overall discussion of the thesis. It integrates the findings from the validation and cohort studies, discusses the strengths and limitations of the research, considers the implications for policy and future research, and highlights the study's contribution to the existing literature.

Chapter 2. Literature Review

2.1 ASD Definition

ASD is a neurodevelopmental condition associated with substantial personal, societal, and economic impacts (3). It typically begins in early childhood and is characterized by differences in social communication and interaction, as well as restricted or repetitive behaviors, interests, or activities. These characteristics emerge early in development but may become more apparent as social demands increase. For a diagnosis, these characteristics must result in clinically significant impairment in social, educational, occupational, or other important areas of functioning and cannot be better explained by intellectual disability or global developmental delay (26).

ASD can be diagnosed as early as 18–24 months of age because its characteristics are sufficiently distinct at this stage to differentiate it from typical development and other developmental conditions (2).

Individuals with ASD often experience co-occurring physical, cognitive, learning, or mental health conditions, which can increase the complexity of daily functioning (27). In addition, some individuals without a formal ASD diagnosis, particularly those with certain mental health conditions, may exhibit autistic traits. These traits have been associated with an increased risk of psychiatric disorders and greater psychological distress (8).

Epidemiological studies have shown a substantial increase in ASD prevalence over recent decades. Chiarotti and Venerosi (28) conducted a global review and reported considerable variation in prevalence estimates across countries, partly reflecting differences in case-identification methods. Despite regional variation in prevalence estimates, the overall prevalence of ASD has increased globally, highlighting its growing importance as a public health concern (28).

2.2 Unified ASD Diagnosis and the Reduction in Reported Cases

The transition from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) in 2013 marked a significant shift in the diagnosis of ASD. Under DSM-5, ASD is classified as a single diagnostic category that encompasses several conditions previously classified separately under DSM-IV, including autistic disorder, Asperger's disorder, childhood disintegrative disorder, and Pervasive Developmental Disorder–Not Otherwise Specified (PDD-NOS). This change reflects the understanding that these conditions represent different manifestations along a continuum rather than distinct disorders (29).

The term *spectrum* highlights the wide range of ways ASD can present across individuals, including differences in cognitive abilities, language development, and behavior (29,30). Some individuals experience significant communication challenges and repetitive behaviors, whereas others exhibit milder characteristics that become apparent only in more complex social situations (8).

According to Halfon and Kuo (31), the introduction of DSM-5 may have reduced the proportion of children meeting diagnostic criteria for ASD. A population-based study by Maenner et al. estimated that approximately 18.8% of children who met DSM-IV-TR criteria for ASD would not meet the revised DSM-5 criteria. Similarly, a systematic review and meta-analysis by Kulage, Smaldone, and Cohn (32) found an overall 31% reduction in ASD diagnoses when DSM-5 criteria were applied, with the largest decrease observed among individuals previously diagnosed with PDD-NOS. Although diagnoses of autistic disorder also declined, the reduction among individuals with Asperger's disorder did not reach statistical significance. The authors also noted that some individuals who no longer meet criteria for ASD under DSM-5 might instead receive a diagnosis

of Social Communication Disorder (SCD), although this appeared to occur in only a small proportion of cases.

A later systematic review and meta-analysis by Kulage et al. (33), conducted five years after the introduction of DSM-5, reported a smaller overall reduction of 20.8% in ASD diagnoses. The largest decreases were observed among individuals previously diagnosed with autistic disorder and Asperger's disorder, whereas changes in PDD-NOS diagnoses were not statistically significant. Similar to earlier findings, some individuals who met DSM-IV criteria no longer qualified for an ASD diagnosis under DSM-5 and may have instead received a diagnosis of SCD, although this affected fewer than one-third of cases.

2.3 Global Prevalence of ASD

In recent years, global efforts have increased public awareness of ASD and improved access to diagnostic and support services. Increased awareness and earlier detection may have contributed to rising prevalence estimates over time. Zeidan et al. (2) reported a median global ASD prevalence of 65 per 10,000 population, compared with 62 per 10,000 reported in an earlier 2012 review.

A recent meta-analysis by Talantseva et al. (3) found substantial regional variation in ASD prevalence, with rates exceeding 1% in North America, compared with 0.73% in Europe and 0.41% in Asia. Higher prevalence estimates were observed in wealthier countries with greater diagnostic capacity and awareness. The study also reported that ASD is most commonly diagnosed among children aged 6–12 years, when diagnoses are generally more reliable (3).

2.4 Prevalence of ASD in Canada

ASD prevalence in Canada has increased steadily over the past decade (34). Data from the Quebec Integrated Chronic Diseases Surveillance System (QICDSS) showed that the prevalence of

diagnosed ASD among children and youth increased over a 10-year period, reaching approximately 1.2% among those aged 1–17 years by 2014–2015 (34).

National surveillance data indicate that ASD prevalence continued to increase, with approximately 2% of Canadian children and youth under 18 years of age diagnosed with ASD by 2019. More than half (53.7%) of diagnoses occurred before five years of age(4).

A recent modelling study estimated that approximately 1.8% of Canadian adults have ASD, with prevalence estimates ranging from 1.6% to 2.0%. ASD was more prevalent among males (2.9%) than females (0.7%). Prevalence also varied across provinces, ranging from 0.7% in Saskatchewan to 3.6% in New Brunswick (27).

2.5 Prevalence of ASD in Manitoba

A population-based study by Hamad et al. (5) used Manitoba's Population Research Data Repository to examine ASD prevalence among children aged 1–5 years between 2004 and 2015. ASD was defined as at least one ASD-related hospitalization or physician claim. The authors found that ASD prevalence more than doubled during the study period, increasing from 0.46% in 2004 to 0.97% in 2015. ASD prevalence was consistently higher among males than females and among urban compared with rural residents (5).

More recently, Singal et al. (35) examined ASD prevalence and incidence among Manitoba children and youth aged 0–17 years using administrative health data from 2011 to 2022. Using a more restrictive case-identification algorithm that required either an ASD-related hospitalization or at least two physician claims within two years, the authors found that ASD prevalence continued to increase, reaching 1.67% in 2022, with an average annual increase of 10.3% since 2011. Incidence also increased, reaching 3.06 per 1,000 individuals in 2022. Like Hamad et al. study,

ASD was more commonly diagnosed among males, and most new diagnoses occurred among children aged 0–5 years.

The prevalence estimates reported by Hamad et al. (5) and Singal et al. (35) are not directly comparable because the studies differed in their age ranges, study periods, and ASD case-identification algorithms. Hamad et al. focused on children aged 1–5 years and used a less restrictive definition requiring only one physician claim, whereas Singal et al. included individuals aged 0–17 years and used a more restrictive definition requiring at least two physician claims within two years. Consequently, differences in prevalence estimates may reflect both changes in ASD prevalence over time and differences in case ascertainment. Together, these studies demonstrate that ASD prevalence in Manitoba has continued to increase while highlighting the influence of case-definition selection on prevalence estimates derived from administrative data.

The 2019 Canadian Health Survey on Children and Youth estimated that 1.7% of Manitoba children and youth had ASD (95% CI: 0.9%–2.5%), a prevalence estimate similar to that reported by Singal et al. using administrative data (4).

2.6 ASD and Criminal Justice System Involvement

As the prevalence of ASD has increased, reports of interactions between individuals with ASD and law enforcement have also grown (7). Some studies suggest that certain behavioral and cognitive characteristics associated with ASD may increase the likelihood of contact with the CJS (36). In addition, reports of negative and sometimes violent encounters with law enforcement (37,38) highlight the need for policy and program changes to better support individuals with ASD.

Evidence of interactions between individuals with ASD and the CJS has been reported in several jurisdictions. In the United Kingdom, nearly one-quarter of a study sample reported interactions

with police as suspects (36). Similarly, a national birth cohort study in New Zealand found that approximately one-quarter of adults with ASD had police interactions (19). In the United States, a representative sample of individuals with ASD showed that approximately 20% had been stopped by police and about 5% had been arrested (39). In Ontario, Canada, studies have reported police interaction rates ranging from 16% to 33% among individuals with ASD (40,41).

Consistent with earlier research (39), Griffiths et al. (42) found that autistic adults were more likely than non-autistic adults to receive police cautions or be arrested; however, they did not observe higher rates of charges, convictions, or imprisonment. The authors suggested that this pattern may reflect increased police contact related to atypical behaviors rather than higher offending rates, although limited statistical power to detect rare outcomes may also have contributed to these findings.

2.7 Misrepresentation of ASD in the Criminal Justice System

Public perceptions of ASD and crime are often influenced by sensational media coverage (37,38) and high-profile criminal cases, which can create the misleading impression that individuals with ASD are more likely to engage in criminal behavior (8,19,43,44). This perception has contributed to ongoing research examining the relationship between ASD and criminal behavior.

A recent review by Dell’Osso et al. concluded that the commonly held belief that individuals with ASD are more likely to commit crimes is not supported by the available evidence and may contribute to stigma and negative attitudes. The authors noted that, in many high-profile cases, there is little or no evidence that the accused had a diagnosis of ASD. Furthermore, cases involving individuals with ASD represent only a small proportion of all criminal cases. Large reviews have not identified a consistent association between ASD and violent or antisocial behavior (8).

2.8 Conflicting Evidence on ASD and Criminal Justice Involvement

In a systematic review of studies published up to 2013, King and Murphy examined the prevalence of CJS involvement among individuals with ASD, the frequency of offending, offence types, mental health conditions, and personal factors associated with offending. Although the reviewed studies suggested that individuals with ASD may be involved in a range of offence types and may have certain vulnerabilities, the authors found no clear evidence that individuals with ASD are overrepresented in the CJS. They also noted that differences in study design, sampling methods, and diagnostic practices limited comparisons across studies and emphasized the need for more rigorous population-based research(45).

Collins et al. reviewed studies published after 2013 and found that, consistent with earlier research, findings remained inconsistent because of methodological differences, small or potentially biased samples, and the absence of matched individuals without ASD. The authors further suggested that the use of non-representative samples may have contributed to variation in reported offending rates (17).

Both King and Murphy (45) and Collins et al. (17) identified important gaps in the literature, including the limited number of studies involving autistic females and insufficient attention to nonviolent or less visible forms of CJS involvement, such as victimization and witness involvement.

2.9 Evidence of Vulnerability and Victimization

Dell’Osso et al. (8) emphasized that autistic individuals, as well as those with developmental and psychiatric disabilities more broadly, experience substantially higher rates of victimization, including assault and robbery. Similarly, Collins et al. (17) reported increased vulnerability to

victimization, social isolation, and self-injurious behavior among autistic individuals involved in the CJS.

A Danish study examined ASD-related characteristics associated with bullying victimization among children. The authors found that the likelihood of victimization increased with the level of ASD traits. Characteristics associated with a higher risk of victimization included loneliness, social isolation, difficulties with cooperation, clumsiness, and challenges in practical judgment. Nearly half of children with ASD experienced bullying, compared with only a small proportion of children without ASD (46).

Another factor contributing to vulnerability is the high prevalence of co-occurring psychiatric conditions among autistic individuals. Among autistic adults without intellectual disability, an estimated 50%–70% experience anxiety disorders, with similar rates reported for depression (42). Evidence suggests that these co-occurring conditions may contribute to justice system contact. Cooper et al. (7) found that additional psychiatric diagnoses strongly distinguished autistic individuals who had police contact from those who did not. Such conditions may increase the likelihood of law enforcement interactions and influence both the nature and outcomes of these encounters.

In a systematic review and meta-analysis, Blanchard et al. (47) found that individuals with ASD were more than three times as likely to engage in self-harm as non-autistic individuals. This elevated risk was observed across age groups, geographic regions, and study designs and was somewhat higher among adults. Complementing this quantitative evidence, Rebbettes and Bacon (48) found that self-harm among autistic women was shaped by both autism-related characteristics and social factors, including delayed diagnosis, burnout, victimization, and misdiagnosis.

Together, these findings suggest that when autistic distress is not adequately recognized or supported, the risk of self-harm may increase.

A population-based study from Denmark found that children with ASD were approximately 2.6 times more likely to experience violent crime than children without ASD (49). Earlier studies have also consistently reported higher rates of peer victimization and bullying among children with ASD, a pattern linked to social-communication and behavioral challenges as well as difficulties in peer relationships (50). These vulnerabilities may persist in adulthood. Using a questionnaire-based design, Griffiths et al. (42) developed the Vulnerability Experiences Quotient (VEQ) and identified multiple forms of victimization among autistic adults. In addition to high rates of childhood bullying, participants reported substantial exposure to physical, verbal, emotional, and sexual abuse throughout the life course. Importantly, the study was the first to identify an association between autism and an increased risk of domestic abuse. Autistic adults reported higher rates of sexual, physical, emotional, and financial abuse by intimate partners. Financial exploitation and material hardship were also common, including unsafe living conditions, unemployment, and coercion into giving away money or possessions.

Overall, these findings indicate that autistic individuals face elevated risks of victimization, self-harm, and other adverse experiences across the life course.

2.10 Advances Through Population-Based Research

Recent population-based studies have begun to address many of the methodological limitations identified in earlier research. A New Zealand birth cohort study by Bowden et al. (19) linked health and justice administrative data to examine justice trajectories from birth to age 25. Individuals with ASD were significantly less likely to be proceeded against by police, charged, or convicted than

individuals without ASD. However, among those who were charged, individuals with ASD were more likely to receive custodial sentences, possibly reflecting the misinterpretation of autism-related characteristics, such as reduced eye contact, as signs of guilt or lack of remorse.

These findings demonstrate the value of population-based data for studying CJS involvement among individuals with ASD. Unlike clinical or forensic samples, which may overrepresent individuals with more complex needs or greater justice involvement, population-based studies include a broader and more representative group of individuals. As a result, they are less vulnerable to selection bias and provide more accurate estimates of CJS involvement at the population level.

2.11 Research Gaps and Study Motivation

There are several gaps in the literature that this study aims to address. First, findings regarding CJSI among individuals with ASD remain inconsistent. While some earlier studies reported higher rates of CJSI among individuals with ASD (13–16), more recent studies have found similar or lower rates of involvement compared with individuals without ASD (8,19,27,45).

In a systematic review of studies published up to 2013, King and Murphy (45) concluded that, although many studies were of reasonable quality, comparisons across studies were difficult because of substantial differences in study populations and methodologies. For example, studies drew participants from offender and forensic samples, specialist clinics, schools, service programs, and community settings. Such variation in sampling approaches may have affected sample representativeness and limited the generalizability of findings (45).

A more recent systematic review by Collins et al. (17) built on the work of King and Murphy by examining studies published after 2013 and assessing whether earlier methodological concerns had been addressed. The authors concluded that high-quality evidence in this area remains limited.

Similar to earlier research, many studies relied on non-representative samples, such as individuals recruited from mental health settings, which may not reflect the broader ASD population. In addition, methodological heterogeneity and the absence of matched individuals without ASD continued to limit comparisons across studies (17).

These limitations have contributed to the inconsistency and uncertainty surrounding the existing evidence on CJSI among individuals with ASD.

Second, few studies have examined CJSI among individuals with ASD across different justice system roles, such as accused persons, victims, and witnesses. Existing research has focused primarily on offending behavior, with comparatively less attention given to victimization and other forms of justice system involvement. Furthermore, many studies have relied on self-reported measures, surveys, or questionnaires to assess CJSI, particularly when examining victimization (21,23–25,46).

Third, many previous studies lacked an appropriate comparison group without ASD, limiting the ability to determine whether observed differences in CJSI were attributable to ASD or to other characteristics of the study population. In their review of studies published after 2013, Collins et al. (17) identified only one study that included a matched comparison group, highlighting the limited use of designs that improve comparability between individuals with and without ASD.

Fourth, study design remains an important limitation in this area of research. Although some previous studies have used retrospective data, they have not adequately examined temporal associations. For example, studies by Hill et al. (51) and Young et al.(52) employed cross-sectional designs, which do not allow the temporal ordering of ASD and CJSI to be assessed. In contrast, this study uses a longitudinal matched cohort design to examine time to first CJSI and the

frequency of CJS contacts over time. This approach allows for a clearer assessment of temporal associations between ASD and CJSI.

To address these gaps, this study uses linked administrative data from Manitoba to examine CJSI among individuals with ASD across the life course. A matched cohort design is used to improve comparability between individuals with ASD and matched individuals without ASD. Age is used as the time scale, and analyses are conducted across different age groups to account for age-related variation in CJSI.

In addition, this study examines multiple roles within the justice system, including accused, victim, and witness. This approach provides a more comprehensive understanding of CJSI among individuals with ASD and allows comparisons with matched individuals without ASD across different stages of life.

Finally, this thesis incorporates a validation study to evaluate multiple ASD case-identification algorithms using Manitoba administrative data. The findings of the validation study are then used to inform the cohort analyses by identifying the most appropriate algorithm for ASD ascertainment. By examining both time to first CJSI and the frequency of CJS contacts, this study provides a more comprehensive assessment of justice system involvement among individuals with ASD and contributes to the growing use of administrative data in ASD research.

Chapter 3. Objective One

Validation of ASD Case Definitions in Administrative Data

3.1 Introduction

3.1.1 Background on Administrative Health Data

Administrative health care data are used widely in public health research and policy. The use of administrative data has become increasingly common because of several advantages. These data are available electronically and relatively inexpensive, and they provide long-term population-level data. Previous studies have examined the advantages and disadvantages of using administrative data, particularly compared with other sources such as surveys or clinical data (53).

3.1.2 Use of Administrative Data for ASD Identification

Administrative health data have been successfully used to identify ASD in population-based studies. They are often used as a cost-effective means of estimating prevalence (54). A systematic review conducted by O'Donnell et al. in 2022 examined administrative case definitions for ASD, Attention-Deficit/Hyperactivity Disorder (ADHD), and Fetal Alcohol Spectrum Disorder (FASD). This study found that the most accurate ASD algorithms typically used information from multiple data sources. Physician claims were the most useful single source for identifying ASD cases. Increasing the number of diagnostic codes improved specificity and positive predictive value (PPV) but reduced sensitivity. The review also found that, among school-aged children, adding education records to physician claims increased sensitivity. These findings highlight the value of incorporating service-based data when available (55).

3.1.3 Common ASD Case Definitions in Administrative Data and Limitations

Previous studies have used different algorithms to identify ASD in administrative data. One common approach, used by Burke et al. and Coleman and colleagues, identifies individuals with ASD based on the presence of the ICD-9 code 299.X on at least two physician billing claims (56,57). However, Bickford highlighted several limitations of these validation studies. According to Bickford, both studies relied on retrospective chart reviews of privately insured children in the United States and had relatively small sample sizes (372 in Burke et al. and 845 in Coleman et al.), which limits the generalizability of their findings. In addition, ASD diagnoses were not confirmed using standardized clinical diagnostic tools. Furthermore, these studies reported only PPV without assessing other important measures such as sensitivity, specificity, or negative predictive value (NPV). Together, these limitations reduce confidence in the accuracy of these algorithms (58).

3.1.4 Validation Studies in Canada

In Canada, several studies have evaluated the accuracy of ASD case identification using administrative data. A study conducted in Nova Scotia evaluated the accuracy of administrative health data for identifying children with ASD using three provincial data sources: Hospital Abstracts, physician billing claims, and mental health outpatient records. Researchers developed seven algorithms based on various combinations of ASD diagnostic codes and compared them against a reference standard. Sensitivity, specificity, and other performance measures were subsequently calculated to assess the accuracy of ASD case identification. The study found that even the simplest ASD case definition, based on a single ASD record in any of these datasets, identified many clinically diagnosed ASD cases. However, the overall sensitivity was moderate, indicating that reliance on a single administrative data source may not capture all clinically confirmed cases of ASD (54).

In British Columbia, a validation study used clinically confirmed ASD diagnoses to assess the validity of provincial administrative health data. These diagnoses were confirmed using standardized diagnostic instruments administered by trained clinicians, specifically the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview–Revised (ADI-R). The ADOS is a semi-structured, standardized assessment that evaluates communication, social interaction, play, and restricted and repetitive behaviors through direct observation of the individual (59). It is widely considered a gold-standard tool for ASD assessment. The ADI-R is a comprehensive, structured interview conducted with a parent or caregiver that focuses on the individual's developmental history and behaviors related to ASD, including social interaction, communication, and restricted and repetitive patterns of behavior. It is also regarded as a gold-standard instrument for supporting ASD diagnosis (60).

The use of both ADOS and ADI-R strengthens the validity of ASD case ascertainment and provides a robust clinical reference standard for validation studies. The study found that although many claim-based algorithms for identifying ASD in administrative data demonstrated high PPVs, they performed less well on other measures of diagnostic accuracy. Consequently, the authors concluded that administrative data alone may not be sufficient to reliably identify ASD. They also highlighted the need for region-specific validation studies, as the performance of administrative case definitions may vary across jurisdictions (58).

3.1.5 Validation Study in Manitoba

In Manitoba, a validation study was conducted to assess the accuracy of administrative data for identifying ASD cases using clinically confirmed diagnoses as the reference standard. The researchers also conducted a mail survey to evaluate cases identified only through administrative data; however, because of the low response rate, only the minimum positive predictive value (PPV) could be estimated. The sensitivity of the administrative case definitions ranged from 80% to 88%, indicating that most clinically confirmed ASD cases could be identified using administrative data. Based on these findings, the authors recommend age-specific ASD case definitions. For children aged 2 to 5 years, either one physician claim or one special education record was sufficient to identify ASD. For individuals aged 6 to 14 years, at least two physician claims or one special education record were required. The authors concluded that these definitions could be used for ASD research in Manitoba (61).

A subsequent Manitoba study by Singal and colleagues (35) used a validated administrative case definition for ASD based on hospital abstracts and physician billing claims. Individuals were identified as having ASD if they had at least one ASD-related hospitalization or at least two physician claims with an ASD diagnosis code within a two-year period. This case definition had

previously been validated against clinically confirmed diagnoses from the Rehabilitation Centre for Children and demonstrated a sensitivity of 77.4%.

3.1.6 ASD Case Definitions Used in the Current Study

Taken together, prior studies show that the identification of ASD in administrative data depends heavily on the case definition used, particularly on the number of physician claims required. Informed by this evidence, the current validation study examines two case definitions that are commonly applied in Manitoba's administrative data. The first definition requires at least one ASD-related physician claim, one hospitalization with an ASD diagnosis code, or one special education record indicating ASD. The second definition requires two or more ASD-related physician claims, one hospitalization with an ASD diagnosis code, or one special education record indicating ASD.

These definitions were evaluated by comparing their sensitivity, specificity, PPV, standard percent positive agreement (PPA), and NPV against a clinically confirmed reference standard. This approach allows assessment of how the number of physician claims affects ASD case identification in Manitoba and directly informs the selection of ASD case definitions used in the subsequent analyses of criminal justice system involvement.

Given the increasing number of children identified with ASD (5) and the availability of detailed clinical data in Manitoba, it is important to evaluate how accurately different data systems identify children with ASD. Accordingly, this chapter examines the level of agreement between Manitoba's administrative health data and clinically confirmed ASD diagnoses recorded by the RCC and CDS.

3.2 Data Sources

A major strength of this study was access to the Manitoba Population Research Data Repository, which enables the linkage of multiple population-based data sources, including health, education, clinical, and disability-service records at the individual level. Such comprehensive linkage is not routinely available for population-based research in most Canadian jurisdictions. By combining information from these complementary sources, particularly the RCC and CDS datasets, this study was able to establish a more accurate ASD case ascertainment.

3.2.1 Rehabilitation Centre for Children

RCC is Manitoba's primary center for assessing children with neurodevelopmental disorders, including ASD, and provides specialized rehabilitation and developmental services. ASD diagnoses at RCC are made by multidisciplinary teams, typically including a developmental pediatrician, psychologist, speech-language pathologist, and occupational therapist, in accordance with national and provincial guidelines. An Autism Diagnostic Observation Schedule (ADOS) assessment may be administered to support diagnosis but is not required in all cases (62). Because assessments are conducted by highly trained specialists, ASD cases identified at RCC are considered highly reliable. RCC provides clinically confirmed ASD diagnoses based on comprehensive multidisciplinary assessments, making it a more reliable source for identifying true ASD cases than physician claims or hospital records. Access to the RCC dataset through the Manitoba Population Research Data Repository is a unique strength of this study, as comparable linked clinical datasets are not routinely available for population-based research in most Canadian provinces. Data from May 1, 2016, to March 31, 2024, were used in this study.

3.2.2 Children's disABILITY Services

The CDS dataset contains information on services and supports provided to Manitoba children under 18 years of age with medically confirmed disabilities, including ASD. CDS identifies children based on their eligibility for provincial disability services, allowing the identification of children with confirmed developmental disabilities who may not be captured through physician claims or hospital records alone. In this study, all available CDS records for children aged 1 to <6 years were used to complement RCC data and strengthen the reference standard used for ASD case ascertainment. The inclusion of both RCC and CDS provided independent clinical and service-based sources for ASD identification, improving the completeness and validity of the reference standard used to evaluate the case definition algorithms.

3.2.3 Medical Claims

The Medical Claims dataset contains physician billing records coded using ICD-9 for insurance services provided in Manitoba. This dataset was used to identify individuals with ASD diagnoses recorded in physician offices. Data from May 1, 2016, to March 31, 2024, were used in this study.

3.2.4 Hospital Abstracts

The Hospital Abstracts dataset contains records of individuals discharged from Manitoba hospitals or who underwent day surgery, with diagnoses coded using ICD-10-CA. This dataset was used to identify individuals with ASD diagnoses recorded in hospital-based care. Data from May 1, 2016, to March 31, 2024, were used in this study.

3.2.5 Enrollment, Marks, and Assessments

The Enrollment, Marks, and Assessments (EMA) dataset contains information on students receiving special education support, including those identified as having ASD by their school divisions. EMA data from the 2015–2016 to 2022–2023 school years were used to identify ASD cases recognized within the education system. This dataset is particularly valuable because it can identify ASD cases that may not be captured in healthcare datasets.

Table 3.1 summarizes the data sources used to identify children in Manitoba with an administrative diagnosis of ASD.

Table 3.01 Data sources used to identify children and youth in Manitoba

Data Source	Time Frame	Description	ASD Diagnosis Codes
Rehabilitation Centre for Children	May 1, 2016 - Mar 31, 2024	This dataset includes information on children aged ≤6 years who have been diagnosed with ASD and contains the following variables: date (DIAGNOSIS_DT), City (CITY), birth date (BIRTH_DT), postal code (POSTAL), province (PROVINCE), Scrambled Personal Health Identification Number (SCRPHIN), sex	The RCC dataset includes only children with clinically confirmed ASD diagnoses.
Children’s disABILITY Services	May 1, 2016 – Mar 31, 2019	It has variables like, SCRPHIN, Client participant demographic information; referral sources; associate relationships and roles; primary disability / diagnosis and other (e.g. hearing, mobility) disability) for children	Children were classified as having autism spectrum disorder (ASD) if they met either of the following criteria: The variable confirmed_primary_disability was recorded as ASD, OR Any of the variables, diagnosis_1 to diagnosis_4, included one of the following diagnostic categories: ASD – Asperger’s Disorder ASD – Childhood Disintegrative Disorder

Data Source	Time Frame	Description	ASD Diagnosis Codes
			ASD – Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS) Autism Spectrum Disorder (ASD) If any of these conditions were met, the individual’s Personal Health Identification Number (PHIN) was considered to represent a child with ASD. Excluded people with ASD – Rett’s Disorder.
Medical Claims	May 1, 2016-Mar31, 2024	This dataset contains physician claims. These claims are submitted by physicians paid through fee-for-service and alternative payment models. Each claim includes one “most responsible” diagnosis. Diagnoses are recorded to the third digit of the ICD-9.	Algorithm One: One or more physician visits with ICD-9 code of 299. Algorithm Two: Two or more physician visits with ICD-9 code of 299
Hospital Abstracts	May 1, 2016-Mar31, 2024	This dataset includes information on admissions to acute and chronic care facilities, as well as outpatient surgeries performed in hospitals. For hospital visits before March 31, 2004, up to 16 diagnoses could be recorded using ICD-9 codes. Starting April 1, 2004, up to 25 diagnoses could be recorded using ICD-10-CA codes.	One or more hospitalizations with an ASD code ICD-9: 299.0, 299.8 299.9. Or ICD-10-CA: F84.0, F84.1, F84.5, F84.8, F84.9.
Enrollment, Marks, and Assessments	2015/16-2022/23	The education dataset includes information about student enrollment, courses, grades, standardized test results, assessments, graduation status, funding, and demographic details for students in Manitoba from kindergarten to Grade 12.	To identify ASD cases, code “ASD” was used under the variable “CATEGORYN” in the Manitoba Education Special Needs data file.

ICD-9 = International Classification of Diseases, 9th Revision, Clinical Modification; ICD-10-CA = International Classification of Diseases, 10th Revision, Canada.

3.3 Study Population

The study population included children who resided in Manitoba, were aged 1 to <6 years, and had a valid Personal Health Identification Number (PHIN) between May 1, 2016, and March 31, 2024.

Within this population, ASD was defined using two measures. The reference standard was based on ASD diagnoses recorded in the RCC or CDS datasets, whereas the comparison measure was based on ASD diagnoses identified in the Hospital Abstracts, Medical Claims, or EMA datasets using the specified administrative case definitions.

3.4 Case Definitions

3.4.1 Administrative ASD Case Definitions

We used two different algorithms using the following datasets to assess the accuracy of each algorithm:

- (1) Hospital Abstracts,
- (2) Medical Claims, and
- (3) EMA

All definitions used for the ASD identification are summarized in table 3.2.

3.4.1.1 Algorithm 1: Relaxed Definition

- ≥ 1 ASD physician claim, OR
- ≥ 1 ASD hospitalization, OR
- ≥ 1 ASD education record

This algorithm increases sensitivity by identifying any child who has at least one ASD-related record in any administrative dataset.

3.4.1.2 Algorithm 2: Restrictive Definition

- ≥ 2 ASD physician claim on different dates, OR
- ≥ 1 ASD hospitalization, OR
- ≥ 1 ASD education record

This version increases specificity for Medical Claims by requiring two physician visits coded for ASD. However, a child can still be identified as having ASD based on a hospital record or an education record alone.

3.5 Analytical Approach

To evaluate the accuracy of ASD identification in administrative data, analyses were conducted using linked data sources within the same study population.

A 2×2 contingency table was structured as follows:

Table 3.2 Contingency Table

	Reference Standard	
	ASD (+)	ASD (-)
Administrative Data (+)	True Positive (TP)	False Positive (FP)
Administrative Data (-)	False Negative (FN)	True Negative (TN)

Validation Metrics:

To evaluate the performance of ASD case definitions in administrative data, several standard diagnostic accuracy metrics were calculated:

- **Sensitivity** ($TP / [TP + FN]$): The proportion of true ASD cases correctly identified in administrative data.
- **Specificity** ($TN / [TN + FP]$): The proportion of non-ASD individuals correctly excluded.
- **PPV**: The proportion of ASD cases identified in administrative data that were confirmed by the reference standard.
- **NPV**: The proportion of non-ASD cases identified in administrative data that were confirmed as non-ASD by the reference standard.
- **PPA**: The proportion of individuals identified as positive by both sources, divided by the average number of positive cases identified by either source. This metric gives equal weight to each dataset.
- **Accuracy**: The overall proportion of correct classifications (both true positives and true negatives) relative to all classifications.
- **Cohen's Kappa**: A measure of agreement between administrative data and the reference standard, adjusted for agreement expected by chance.
- **McNemar's Test**: A statistical test used to assess systematic differences between paired classifications in the administrative and reference standard datasets.

All analyses were conducted in SAS 9.4.

3.6 Results

This section presents the results of comparing ASD identification in Manitoba using clinical, service, and administrative data under two administrative case definitions. The results are organized into four parts. First, the demographic and clinical characteristics of individuals identified with ASD in the RCC, CDS, and administrative datasets are described for each

definition. Second, overlap in ASD case ascertainment across data sources is examined, and agreement patterns between the one-claim and two-claim definitions are compared using figures. Third, measures of agreement are presented for each definition, including sensitivity, specificity, positive predictive value (PPV), positive percent agreement (PPA), and negative predictive value (NPV). Finally, the implications of these findings for ASD case ascertainment in administrative data are summarized.

3.6.1 Descriptive Characteristics of Identified ASD Cases

This subsection describes the demographic characteristics of individuals with ASD identified through the RCC, CDS, and administrative case definitions (Table 3.3) within the study population. The analysis examines whether demographic characteristics differ across data sources and ASD case definitions. Variables assessed include age at diagnosis, sex, region of residence, and neighborhood-level socioeconomic status.

Table 3.3 Demographic Characteristics of ASD Cases

Variable	Reference Standard	Relaxed Algorithm	Restrictive Algorithm
Total Cases	3302	5391	2788
Age (mean $\pm$ SD)	3.92 (1.02)	3.67 (1.2)	3.50 (1.14)
Sex			
-Male	75.92%	74.22%	74.25%
-Female	24.08%	25.78%	25.75%
Geographical Location			
-Urban	72.11%	69.99%	72.27%
-Rural	27.89%	30.01%	27.73%
Neighborhood Socioeconomic Status			
-Q1 (least advantaged)	841 (25.47 %)	1460 (27.08 %)	730 (26.18 %)
-Q2	796 (24.11 %)	1344 (24.93 %)	651 (23.35 %)
-Q3	646 (19.56 %)	1036 (19.22 %)	535 (19.19 %)
-Q4	553 (16.75 %)	847 (15.71%)	456 (16.36 %)
-Q5 (most advantaged)	436 (13.20 %)	681 (12.63%)	385 (13.81 %)
-Not Found	30 (0.91 %)	23 (0.43 %)	31 (1.11 %)

Regional Health Authority (RHA)			
-Interlake-Eastern RHA	206 (6.24%)	346 (6.42%)	163 (5.85%)
-Northern Health Region	230 (6.97%)	486 (9.02%)	232 (8.32%)
-Southern Health-Sante Sud	333 (10.08%)	504 (9.35%)	243 (8.72%)
-Prairie Mountain Health	273 (8.27%)	506 (9.39%)	268 (9.61%)
-Winnipeg RHA	2260 (68.44%)	3549 (65.83%)	1882 (67.50%)

The relaxed algorithm definition uses administrative data with the following criteria: ≥ 1 Medical Claims, or a record in the Hospital Abstracts or EMA datasets. The restrictive definition uses administrative data with the following criteria: ≥ 2 Medical Claims, or a record in the Hospital Abstracts or EMA datasets. The reference standard consists of clinical and service data, including the RCC and CDS datasets.

In addition to demographic characteristics, this subsection presents the annual number of newly identified ASD cases under the relaxed and restrictive administrative definitions and the reference standard (Table 3.4). Comparing annual case counts across definitions provides insight into differences in ASD ascertainment and the extent to which the administrative definitions approximate the reference standard. These descriptive analyses help characterize patterns of ASD identification across data sources and over time.

Table 03.4 Yearly Distribution of ASD Cases

Year of Diagnosis	Reference Standard		Relaxed Algorithm		Restrictive Algorithm	
	Frequency	Column Percent	Frequency	Column Percent	Frequency	Column Percent
2016	284	8.60	442	8.20	300	10.76
2017	396	11.99	588	10.91	371	13.31
2018	281	8.51	409	7.59	236	8.46
2019	252	7.63	443	8.22	255	9.15
2020	267	8.09	517	9.59	303	10.87
2021	585	17.72	837	15.53	464	16.64
2022	564	17.08	945	17.53	506	18.15
2023	489	14.81	979	18.16	321	11.51

Year of Diagnosis	Reference Standard		Relaxed Algorithm		Restrictive Algorithm	
	Frequency	Column Percent	Frequency	Column Percent	Frequency	Column Percent
2024*	184	5.57	231	4.28	32	1.15
Total	3302	100	5391	100	2788	100

*Up to March 31, 2024.

3.6.2 Overlap in ASD Case Identification Across Data Sources

To assess consistency in ASD ascertainment across data sources, we examined the overlap in ASD case identification under the reference standard (RCC and CDS) and the relaxed and restrictive administrative case definitions. This analysis evaluated the extent to which the same individuals were identified across data sources and how the choice of administrative case definition influenced this overlap.

Cross-tabulation tables were constructed to compare ASD identification across data sources within the study population for each case definition. These tables summarize agreement and disagreement between data sources, including the proportion of individuals identified with ASD in the RCC or CDS datasets who were also captured in health and education records. Comparing results across definitions allowed assessment of whether the restrictive definition improved agreement with the reference standard or resulted in missed cases.

Table 3.5 Agreement Between the Relaxed Administrative Definition and the Reference Standard for ASD Identification

Administrative Data (Relaxed Algorithm)	Reference Standard						Total
	ASD (+)			ASD (-)			
	Count	Row Percentage	Column Percentage	Count	Row Percentage	Column Percentage	
ASD (+)	3086	57.24%	93.46%	2305	42.76%	0.98%	5391
ASD (-)	216	0.09%	6.54%	231953	99.91%	99.02%	232169
Total	3302	1.39	100%	234258	98.61%	100%	237560

The population cohort consisted of 237560 unique PHINs aged 1 to <6 years during the period May 1, 2016, to March 31, 2024. Approximately 2.36% (2305+216+3086) of the cohort had at least one recorded ASD diagnosis during the study period. There were 3086 (1.3 %) PHINs with an ASD diagnosis recorded in both the reference standard and the administrative datasets (Hospital Abstracts, Medical Claims, or Education). Additionally, 216 (0.09 %) PHINs had an ASD diagnosis recorded only in RCC or CDS datasets, while 2305 (0.97 %) PHINs had an ASD diagnosis recorded only in the administrative datasets.

Table 3.6 Agreement Between the Restrictive Administrative Definition and the Reference Standard for ASD Identification

Reference Standard							
Administrative Data (Restrictive Algorithm)	ASD (+)			ASD (-)			Total
	Count	Row Percentage	Column Percentage	Count	Row Percentage	Column Percentage	
ASD (+)	2027	72.70%	61.39%	761	27.30%	0.32%	2788
ASD (-)	1275	0.54%	38.61%	233497	99.46%	99.68%	234772
Total	3302	1.39%	100%	234258	98.61%	100%	237560

The population cohort consisted of 237560 unique PHINs aged 1 to <6 years during the period May 1, 2016, to March 31, 2024. This table accounts for the more restrictive case definition in Medical Claims: 2 or more records of ASD. Approximately 1.71% (2027+761+1275) of the cohort had at least one recorded ASD diagnosis based on the definitions of the clinical and more restrictive administrative data during the study period. There were 2027(0.85%) PHINs with an ASD diagnosis recorded in both the RCC and CDS datasets and the administrative datasets (Hospital Abstracts, Medical Claims [2 or more], or Education). Additionally, 1275 (0.54%) PHINs had an ASD diagnosis recorded only in RCC or CDS datasets, while 761 (0.32%) PHINs had an ASD diagnosis recorded only in the administrative datasets.

Figures 3.1 and 3.2 present the distribution of ASD diagnoses across the different datasets. Figures 3.3 and 3.4 use Venn diagrams to illustrate the overlap in ASD case identification across data sources, including the number of cases identified in multiple datasets and those identified in only a single source.

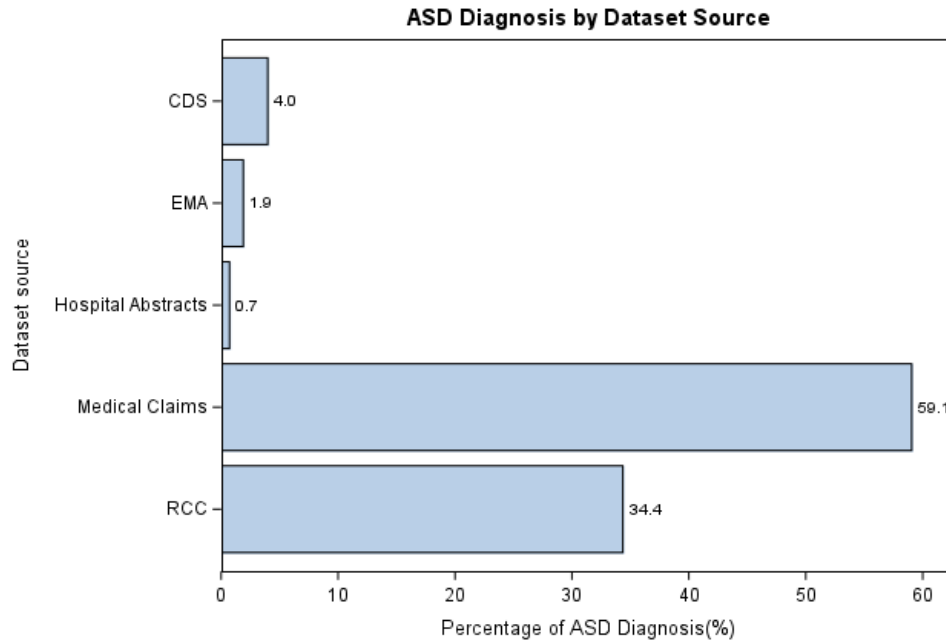


Figure 3.1 ASD Diagnosis by Dataset Source for the Relaxed Algorithm

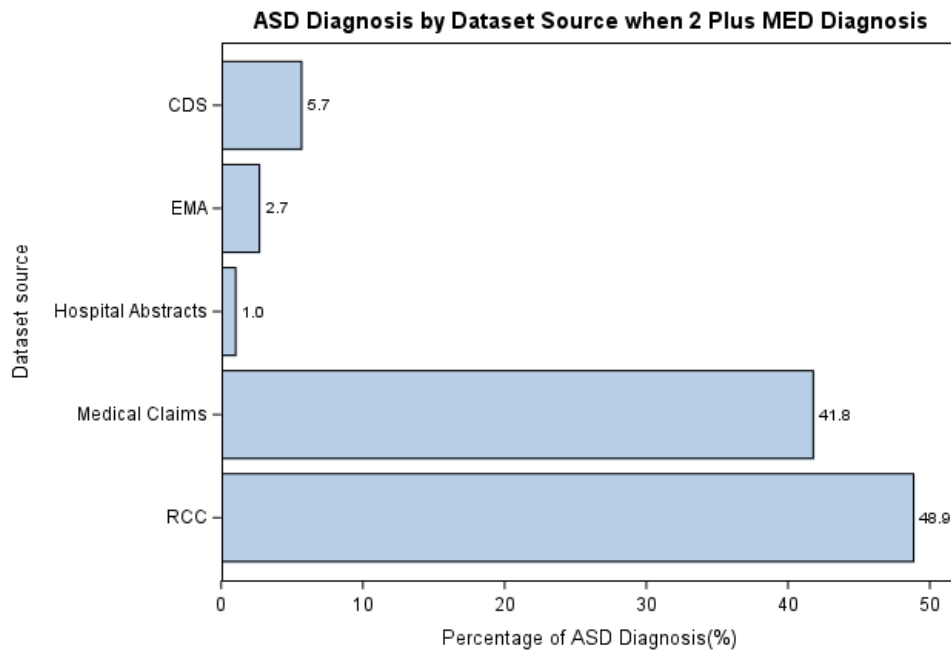


Figure 3.2 ASD Diagnosis by Dataset Source for the Restrictive Algorithm

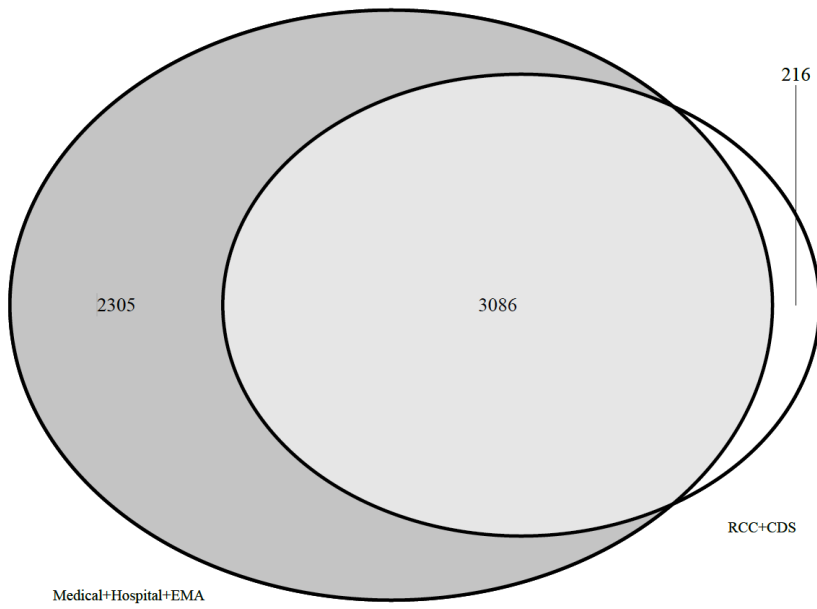


Figure 3.3 Overlap in ASD Case Identification Across Data Sources Using the Relaxed Definition

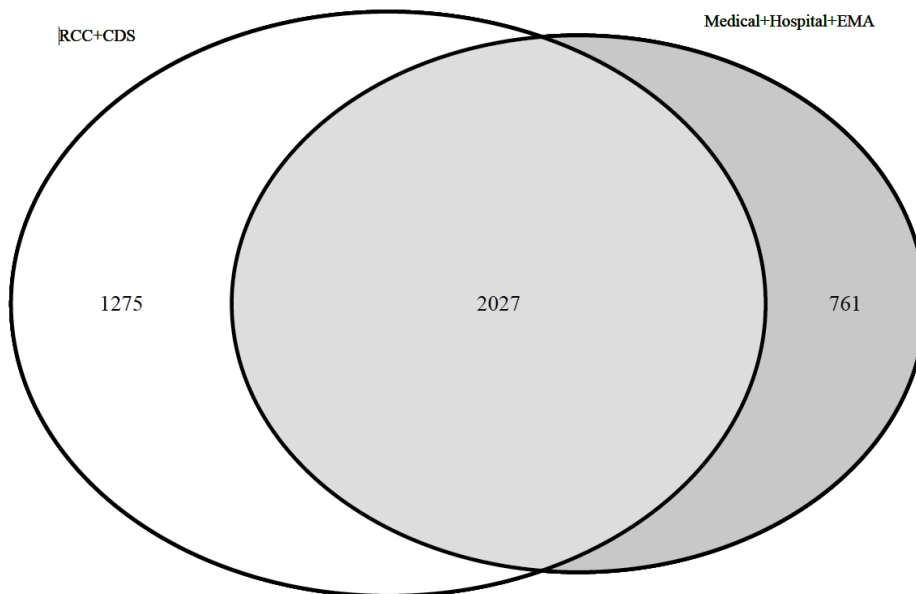


Figure 3.4 Overlap in ASD Case Identification Across Data Sources Using the Restrictive Definition

3.6.3 Agreement Between Data Sources

This subsection evaluates the extent to which the administrative ASD case definitions align with the reference standard derived from RCC and CDS data within the same study population. Agreement was assessed for both relaxed and restrictive administrative definitions. This analysis provides insight into how the choice of case definition influences the accuracy of ASD identification.

For each definition, common validation measures were calculated, including sensitivity, specificity, positive predictive value (PPV), positive percent agreement (PPA), and negative predictive value (NPV). These measures assess how well the administrative definitions identify individuals with ASD and correctly classify individuals without ASD relative to the reference standard. Cohen's kappa was also calculated to summarize overall agreement while accounting for agreement expected by chance.

To facilitate comparison, all agreement measures are presented in a single summary table (Table 3.8). This table allows direct comparison of the relaxed and restrictive definitions and highlights the trade-offs between sensitivity, specificity, PPV, PPA, and NPV. Presenting the results together helps illustrate whether more restrictive criteria improve agreement with the reference standard or result in missed ASD cases.

Table 3.7 Agreement Metrics Summary Table

Measure	Algorithm One (Relaxed)	Algorithm Two (Restrictive)
Sensitivity	93.4%	61.4%
PPA	70.1%	66.5%
Specificity	99.0%	99.7%
PPV	57.2%	72.7%
NPV	99.9%	99.4%
Accuracy	98.9%	99.1%

Measure	Algorithm One (Relaxed)	Algorithm Two (Restrictive)
McNemar's Test		
-Chi-Square	1731.0278	129.7623
-P-Value	<.0001	<.0001
Simple Kappa Coefficient		
-Estimate	0.7049	0.6614
-Standard Error	0.0056	0.0070
-95% LCL	0.6940	0.6476
-95% UCL	0.7159	0.6752

All the accuracy measures for this validation study are summarized in this table.

Algorithm 1, the relaxed ASD case definition, showed high sensitivity (93.4%) but moderate PPA (70.1%) and PPV (57.2%). The specificity and NPV were 99.0% and 99.9%, respectively. According to the Landis and Koch (1977) benchmarks (9), its agreement with the reference standard was substantial ($\kappa = 0.70$; 95% CI: 0.694–0.716).

Algorithm 2, which is the restrictive ASD case definition, had a higher PPV (72.7%) but much lower sensitivity (61.4%) and moderate PPA (66.5%). Specificity (99.7%) and NPV (99.4%) remained very high. Agreement with the reference standard for Algorithm 2 was substantial ($\kappa = 0.66$; 95% CI: 0.648–0.675).

Both algorithms achieved an overall accuracy of approximately 99%. McNemar's tests showed significant differences between each administrative definition and the reference standard ($p < 0.0001$).

3.7 Discussion

In this validation study, we evaluated the extent to which two administrative ASD case definitions accurately identified ASD among children aged 1 to <6 years in Manitoba. ASD status was determined using diagnoses recorded in the RCC and CDS datasets, which together served as the reference standard.

The relaxed definition classified individuals as having ASD if they had at least one physician claim, one hospital record, or one education record indicating an ASD diagnosis. This definition demonstrated high sensitivity and successfully identified most ASD cases captured by the reference standard. However, because the criteria were less restrictive, it also identified a greater number of individuals who were not classified as ASD cases by the reference standard, resulting in a lower PPV.

In contrast, the restrictive definition required two or more physician claims, while the criteria for the other data sources remained the same as those used in the relaxed definition. This approach resulted in lower sensitivity but substantially higher PPV. Consequently, individuals identified using the restrictive definition were more likely to represent true ASD cases according to the reference standard. However, the increased specificity of the criteria came at the cost of missing a greater number of true ASD cases. Overall, these findings illustrate the trade-off between sensitivity and PPV when selecting administrative case definitions for ASD.

PPA was calculated because the reference standard was not assumed to be perfect. The difference between the two administrative definitions was modest, with both demonstrating moderate agreement with the reference standard (70.1% vs. 66.5%). These findings suggest that although the relaxed definition identified more ASD cases captured by the reference standard, both definitions showed a similar level of overall agreement with the reference standard.

Both definitions demonstrated very high specificity, NPV, and overall accuracy. However, these measures should be interpreted cautiously because ASD is relatively uncommon in the general population. When a condition has low prevalence, most individuals do not have the condition, which can lead to inflated estimates of specificity, NPV, and overall accuracy. As a result, these

measures may be less informative for evaluating performance in this context. Measures such as sensitivity, PPV, PPA, and Cohen's kappa provide more meaningful information regarding the validity of the administrative definitions. Based on the kappa statistics, both definitions showed substantial agreement with the reference standard. Overall, these findings suggest that administrative data can be used to identify ASD with reasonable accuracy, although performance varies depending on the case definition applied.

Our findings are consistent with previous research. As shown in the results, the relaxed algorithm, which requires only a single physician claim in the Medical Claims dataset, generally demonstrated higher sensitivity (54), whereas the restrictive algorithm, which requires multiple physician claims, increased PPV at the expense of sensitivity (63,64). These findings illustrate the trade-off between maximizing case identification and increasing diagnostic certainty. Similarly, Brownell et al. (61) reported that broader ASD definitions may be more suitable in early childhood, when diagnoses are still evolving and administrative data may not yet fully capture clinically confirmed cases.

Overall, the findings suggest that administrative data can identify ASD in young children with reasonable accuracy, although the optimal case definition depends on the research objective. For the cohort study examining CJSI among individuals with ASD, the restrictive definition was selected for the primary analyses because it provided greater confidence that identified cases truly had ASD. The relaxed definition was retained for sensitivity analyses to assess the robustness of the findings under a broader case ascertainment approach.

3.8 Strengths and Limitations

3.8.1 Strengths

First, the RCC and CDS datasets were used as the reference standard. RCC contains clinically confirmed ASD diagnoses made by multidisciplinary teams, while CDS includes children with medically confirmed disabilities receiving disability services. Together, these datasets provided the best available reference standard for identifying ASD cases in Manitoba.

Second, by including two commonly used administrative ASD case definitions, the study directly compared restrictive and relaxed approaches within the same population.

Third, the use of multiple linked population-based datasets allowed ASD cases to be identified across healthcare, education, and disability service systems, increasing the completeness of case ascertainment.

Finally, the use of several validation measures, including sensitivity, specificity, PPV, PPA, NPV, and Cohen's kappa, provided a comprehensive assessment of the performance of each administrative case definition.

3.8.2 Limitations

This study has several important limitations. First, measures such as specificity, NPV, and overall accuracy may appear high because ASD is relatively uncommon in the general population. As a result, these measures may overstate algorithm performance and should be interpreted alongside sensitivity, PPV, PPA, and Cohen's kappa.

Second, some children with ASD may not have been captured in either the administrative datasets or the reference standard. ASD diagnoses often occur later in childhood, referral pathways vary, and early developmental concerns may not yet be reflected in administrative records. In addition, although the RCC and CDS datasets provided the best available reference standard for this study, they do not include all children with ASD in Manitoba. Some children may receive diagnoses through other clinical pathways or may not access services through RCC or CDS.

Finally, because the study was restricted to children aged 1 to <6 years, the findings may not be generalized to older children and adolescents, whose ASD diagnoses may be more completely captured in administrative and clinical records.

3.9 Implications for Cohort Construction and Transition to Chapter 4

The validation study informed the construction of the cohort used to examine CJSI among individuals with ASD. The findings showed that the relaxed definition had higher sensitivity and identified a larger number of ASD cases, whereas the restrictive definition had a higher PPV, providing greater confidence that identified individuals truly had ASD.

Misclassification of ASD status can bias estimates of the association between ASD and CJSI. Specifically, including false-positive ASD cases may attenuate the observed association by introducing individuals who do not have ASD into the exposed group. Therefore, the restrictive definition was selected for the primary cohort analyses because its higher PPV reduced the likelihood of false-positive case identification, despite potentially missing some true ASD cases.

The relaxed definition was retained for sensitivity analyses to evaluate the robustness of the findings under a broader case ascertainment approach. In addition, separate analyses were

conducted among individuals who met the relaxed definition but not the restrictive definition to assess the potential impact of diagnostic uncertainty on the observed associations.

Together, these analyses demonstrate how the choice of ASD case definition can influence population-based research findings and highlight the importance of validating administrative case definitions before examining long-term outcomes.

Chapter 4. Objective Two

Criminal Justice System Involvement among Individuals with ASD

This chapter addresses the second objective of the thesis: to examine CJSI among individuals with ASD compared with matched individuals without ASD in Manitoba.

Chapter 3 evaluated the validity of two administrative ASD case definitions using a reference standard based on RCC and CDS records. The findings demonstrated a trade-off between sensitivity and PPV. Based on these results, the restrictive ASD definition was selected for the primary analyses to reduce exposure misclassification, while the relaxed definition was retained for sensitivity analyses.

Using these case definitions, this chapter examines patterns of CJSI in a population-based retrospective matched cohort study conducted using linked administrative data available through the MCHP. Individuals with ASD were matched to individuals without ASD on age, sex, and RHA.

The analysis examines both time to first CJSI and the frequency of CJS contacts. Involvement in the CJS is assessed overall and by role, including accused, victim, and witness involvement. To account for variation across the life course, analyses are conducted separately for childhood, youth, and adulthood.

Together, these analyses provide a comprehensive population-based assessment of CJSI among individuals with ASD in Manitoba.

4.1 Methods

4.1.1 Study design

This retrospective matched cohort study examined the association between ASD and subsequent CJSI. Linked administrative data were used to establish the temporal sequence between ASD and CJSI and to estimate associations in a population-based setting. Individuals with ASD were identified using multiple administrative datasets. Everyone with ASD was matched to three individuals without ASD on age, sex, and RHA. Participants were then followed to examine the occurrence and frequency of CJSI over time.

4.1.2 Data Sources

This study used multiple population-based administrative datasets available through MCHP. These datasets contain health, education, registry, social and family, and justice information for nearly all Manitoba residents. Individual-level linkage was achieved using a scrambled Personal Health Identification Number (SCRPHIN). The following data sources were used to identify ASD cases, covariates, and CJSI.

4.1.2.1 ASD Case Identification Data Sources

Rehabilitation Centre for Children

The RCC is Manitoba's primary center for the assessment of children with neurodevelopmental conditions, including ASD, and provides specialized rehabilitation and developmental services. ASD diagnoses at RCC are made by multidisciplinary teams, typically including developmental pediatricians, psychologists, speech-language pathologists, and occupational therapists, in accordance with national and provincial guidelines. An Autism Diagnostic Observation Schedule (ADOS) assessment may be administered to support diagnosis but is not required in all cases (62).

Because assessments are conducted by highly trained specialists using standardized diagnostic approaches, ASD diagnoses recorded in RCC are considered highly reliable. Data from May 1, 2016, to March 31, 2024, were used in this study.

Children’s disABILITY Services

The CDS dataset contains information on services and supports provided to Manitoba children under 18 years of age with medically confirmed disabilities, including ASD. In this study, all available CDS records for children aged 1 to <6 years were used to complement RCC data and improve ASD ascertainment.

Medical Claims (Physician Claims)

The Medical Claims dataset contains physician billing records coded using ICD-9 diagnostic codes for physician services covered by insurance. It was used to identify ASD diagnoses recorded between January 1, 1979, and March 31, 2024.

Hospital Abstracts

The Hospital Abstracts dataset contains records of hospital discharges and day surgeries, with diagnoses coded using ICD-10-CA. Data from January 1, 1979, to March 31, 2024, were used to identify ASD diagnoses. Together with the Medical Claims dataset, it provides one of the primary long-term sources for identifying ASD cases over the study period.

Enrollment, Marks, and Assessments

The EMA dataset contains information on students receiving special education supports, including students identified as having ASD by their school divisions. EMA data from the 1995–1996 to the

2022–2023 school years were used to identify ASD cases recognized within the education system. This dataset may capture ASD cases that are not identified in administrative health datasets.

4.1.2.2 Justice Data Source

Prosecutions Information Management System (PRISM)

The PRISM dataset contains detailed information on criminal justice events and identifies whether an individual was involved in a police-reported incident as an accused person, victim, or witness. In this study, PRISM data from September 1, 2002, to March 31, 2025, were used to identify CJSI, measure time to first CJSI, and calculate the number of CJS contacts

4.1.2.3 Additional Administrative Data Sources

Other routinely collected administrative datasets from the Repository were used to identify covariates, including demographic characteristics, socioeconomic status, immigration status, health service use, and residency information.

Manitoba Health Insurance Registry (MHIR)

The Manitoba Health Insurance Registry contains information on all individuals eligible for Manitoba health coverage since 1970. For this study, data from January 1, 1979, to March 31, 2025, were used. The registry includes demographic information, residential history, and records of out-migration and health coverage status.

Immigration, Refugees and Citizenship Canada (IRCC)

The IRCC dataset contains information on individuals who immigrated to Canada as temporary or permanent residents. In this study, it was used to determine maternal immigration status. Data were available from January 1, 1985, to March 31, 2025.

Manitoba FASD Center

The Manitoba FASD Centre database contains information on individuals assessed for FASD according to Canadian diagnostic guidelines. In this study, the database was used to identify and exclude individuals with FASD because of the overlap in neurodevelopmental and behavioral characteristics between FASD and ASD, and because FASD is independently associated with adverse outcomes, including increased CJS involvement. Diagnostic information from January 1, 1999, to December 31, 2020, was used.

4.1.3 ASD Case Definition and Algorithms

ASD cases were identified using five linked administrative datasets. These datasets were the RCC, CDS, Medical Claims, Hospital Abstracts, and EMA.

Two administrative case definitions were developed to evaluate how different ASD identification rules influence case ascertainment and study findings.

4.1.3.1 Algorithm 1: Relaxed Definition

An individual was classified as having ASD if they met any of the following:

≥ 1 ASD-related physician claim, OR

≥ 1 ASD-related hospitalization, OR

≥ 1 ASD-related education record, OR

ASD diagnosis in RCC, OR

ASD diagnosis in CDS

This definition has higher sensitivity, as it requires only one medical claim record for ASD.

4.1.3.2 Algorithm 2: Restrictive Definition

An individual was classified as having ASD if they met any of the following:

≥ 2 ASD-related physician claims on different dates, OR

≥ 1 ASD-related hospitalization, OR

≥ 1 ASD-related education record, OR

ASD diagnosis in RCC, OR

ASD diagnosis in CDS

This definition has a higher PPV because it requires at least two ASD-related physician claims in the Medical Claims dataset. Although it improves diagnostic precision, it has lower sensitivity and may fail to identify some true ASD cases.

4.1.3.3 Discordant Group

A third study group was created consisting of individuals who met the relaxed definition but did not meet the restrictive definition. Specifically, these individuals had exactly one ASD-related physician claim and no ASD-related hospitalization, education record, RCC diagnosis, or CDS diagnosis.

This group was created to examine associations among individuals who did not meet the more restrictive Medical Claims criterion. Examining this subgroup helps assess the potential impact of misclassification and provides insight into how changes in algorithm strictness may influence ASD case identification and study findings.

4.1.3.4 Public Health Agency of Canada (PHAC) Definition

In addition to the study-specific algorithms, the Public Health Agency of Canada (PHAC) ASD case definition was examined in sensitivity analyses. The PHAC algorithm was developed to support national public health surveillance of ASD among children and youth using Canadian administrative health data. The original PHAC definition identifies children and youth aged 1–19 years as having ASD if they have at least one hospitalization with an ASD diagnosis code or two or more physician claims with an ASD diagnosis code. For consistency with the study population, the PHAC definition was adapted and applied only to children aged 1 to <6 years in this study. As an established and widely recognized case definition, it provides an external benchmark for evaluating the robustness of the study findings. However, because the PHAC algorithm was developed for surveillance purposes and relies only on hospital discharge abstracts and physician claims, it was not selected as the primary case definition. Instead, the primary analyses used the Manitoba-specific algorithm identified through the validation study, which was developed and evaluated using linked clinical and administrative datasets, including the Rehabilitation Centre for Children (RCC) and Children's disABILITY Services (CDS). Including the PHAC algorithm in the sensitivity analyses allowed us to determine whether the observed associations remained consistent when an established national surveillance definition was applied.

4.1.4 ASD Case Identification and Index Date Assignment

Individuals were classified as ASD cases if they met the criteria for either ASD case-identification algorithm during the study period.

For individuals with ASD, the index date was defined as the earliest date on which an ASD diagnosis was recorded in any of the five ASD ascertainment datasets (RCC, CDS, Medical

Claims, Hospital Abstracts, or EMA). If an individual had ASD records in multiple datasets, the earliest recorded date was used.

4.1.5 Inclusion and Exclusion Criteria

Individuals were eligible for inclusion if they met the criteria for one of the ASD case-identification algorithms or were selected as matched individuals without ASD. All participants were required to have active Manitoba health coverage and reside in Manitoba on the index date.

Individuals were excluded if they:

- had missing or invalid key variables (date of birth, sex, immigration status, RHA, index date, or linkage identifier);
- had a recorded diagnosis of FASD;
- had experienced CJSI before the index date;
- had no observable risk time after September 1, 2002, the date on which PRISM data became available; or
- experienced a gap in Manitoba health coverage exceeding 365 days during follow-up.

Participants who left Manitoba or experienced a gap in health coverage exceeding 365 days were excluded because extended absences increase the likelihood of missing relevant health and justice system information.

4.1.6 Matched Cohort Creation

Individuals with ASD were first identified and assigned an index date. For each individual with ASD, three individuals without ASD were selected from the Manitoba population and matched on

sex, age at index date (± 0.5 years), and Regional Health Authority (RHA). To be eligible, matched individuals without ASD could not have any ASD-related records in the RCC, CDS, Medical Claims, Hospital Abstracts, or EMA datasets at any time. Each matched individual without ASD was assigned the same index date as their matched ASD case to ensure comparable follow-up periods.

Separate childhood, youth, and adult cohorts were subsequently created. The number of individuals with ASD and matched individuals without ASD in each cohort is presented in the Results chapter.

Three analytic cohorts were examined: the relaxed ASD cohort, the restrictive ASD cohort, and the discordant subgroup. Final sample sizes for the primary analyses are presented in the Results chapter, whereas sample sizes for the sensitivity analyses are presented in the Appendix.

4.1.7 Follow-Up and Censoring

For each matched set, follow-up began on the later of:

- the case's index date (the same date assigned to matched individuals without ASD), or
- September 1, 2002, the start of PRISM data availability.

For the time-to-first-event analyses, follow-up continued until the earliest occurrence of:

- first CJSI,
- death,
- out-migration from Manitoba or loss of health coverage, or
- March 31, 2025, the end of the study period.

For the frequency analyses, participants remained under observation after their first CJSI and were followed until death, out-migration from Manitoba, loss of health coverage (gap >365 days), or March 31, 2025, allowing all CJS events during follow-up to be counted.

4.1.8 Outcome Definition

4.1.8.1 Event Hierarchy for Same-Day Records

An individual could appear in more than one role within the same incident, for example, as both an accused person and a victim. To assign a single role for the first CJSI, the following predefined hierarchy was applied:

- Accused (highest priority)
- Victim
- Witness (lowest priority)

If multiple roles occurred on the same date, the highest-priority role was assigned. This hierarchy was used only to classify the first CJSI and did not affect role-specific count outcomes.

4.1.8.2 Primary Outcome: Time to First CJSI

The primary outcome was time from cohort entry to first CJSI. An individual was considered to have experienced a CJSI event if they appeared in the PRISM dataset as an accused person, victim, or witness. The event date was defined as the first occurrence of any of these roles during follow-up.

Role-Specific Outcomes Based on First Involvement

To examine associations between ASD and specific types of CJSI, three role-specific outcomes were defined based on an individual's role at their first CJSI:

- first involvement as an accused person;
- first involvement as a victim; and
- first involvement as a witness.

For individuals with multiple PRISM records, the role recorded at the earliest CJSI determined their classification. Each individual contributed to only one role-specific outcome, ensuring that analyses were based on the initial type of CJSI rather than subsequent events.

4.1.8.3 Frequency Outcomes

To examine the frequency of CJSI during follow-up, count-based outcome variables were created using records from the PRISM dataset. These outcomes captured repeated contacts with the CJS as an accused person, victim, or witness.

Total CJS Contact Count

The primary count outcome was the total number of CJS events recorded in PRISM for each individual during follow-up, regardless of role. Events involving an accused person, victim, or witness were all included. Each event was counted separately, including multiple events experienced by the same individual over time.

Role-Specific CJS Contact Counts

In addition to total CJSI, role-specific count outcomes were created to examine the frequency of CJS contacts by type of involvement. Separate counts were defined for:

accused events,

victim events, and

witness events.

For each role, the count represented the total number of PRISM-recorded contacts occurring during follow-up.

4.1.8.4 Observation Window

PRISM data were available from September 1, 2002, to March 31, 2025. All CJS outcomes were measured within this observation window, and events occurring outside this period were not included in the analysis.

4.1.9 Matched Variables

Individuals with ASD and matched individuals without ASD were matched in a 1:3 ratio based on sex, age at the index date (within ± 0.5 years), and RHA. As a result of this matching, the two groups had comparable distributions of these variables. Therefore, sex, age, and RHA were not included as covariates in the regression models because they were accounted for through matching. However, these variables are reported in the descriptive analyses.

4.1.10 Covariates

Covariates were selected based on prior research and their relevance to both ASD and CJSI. Data availability for each variable was also considered when determining which covariates to include in the study.

4.1.10.1 Socioeconomic Status (SEFI)

Socioeconomic status was measured using SEFI-2, a census-based index that reflects non-medical social determinants of health at the area level. It is calculated using variables such as income, education, unemployment, and single-parent households, and assigned to individuals based on the postal code of their residence at the start of the study. SEFI-2 scores range from negative (more favorable socioeconomic conditions) to positive (less favorable conditions). In regression models, SEFI-2 was treated as a continuous variable to preserve detail and statistical power, while income quintiles (Q5 = most advantaged; Q1 = least advantaged) were used for descriptive analyses to improve interpretability.

4.1.10.2 Immigration Status

Immigration status was obtained from the Immigration, Refugees and Citizenship Canada (IRCC) database. In this study, maternal immigration status was used as an indicator of the family's immigration background.

Mothers were classified as either:

- Immigrant, or
- Non-immigrant.

This variable was used because it provides a proxy measure of the family's immigration experience and early-life social environment, which may influence both ASD identification and later CJSI.

4.1.10.3 Mental Health Comorbidities

Mental health comorbidities were defined using diagnostic codes from Medical Claims and Hospital Abstracts and included:

- Mood and anxiety disorders, and
- Intellectual developmental disorders (IDD).

An individual was considered to have a mental health comorbidity if they had at least one diagnostic record for these conditions. Mental health comorbidities were included as a binary variable.

Mental health comorbidities were identified based on diagnoses recorded at any time during the study period, without restricting their timing relative to ASD diagnosis or the onset of CJSI. As a result, these variables may represent a combination of pre-existing conditions that could act as confounders, as well as conditions that developed after ASD diagnosis and may lie on the causal pathway (i.e., potential mediators). Therefore, adjustment for these variables may partially account for both confounding and mediating effects.

Including mental health comorbidities allowed adjustment for additional challenges and service needs that may influence the relationship between ASD and CJSI. However, because these diagnoses were not temporally restricted, they should not be interpreted as purely confounding factors.

4.1.10.4 Geographic Location

Geographic location was defined using each individual's RHA at the index date. RHA was used as a matching variable and, therefore, was not included as a covariate in the regression models. However, it was included in the descriptive tables to demonstrate the comparability of individuals with ASD and matched individuals without ASD by geographic location and to characterize the study population.

4.1.11 Statistical Analysis

All analyses in the study were conducted in the MCHP secure environment using R and SAS. Results were considered significant if the p-value was less than 0.05. All analyses were performed separately for each of the ASD definitions, including the relaxed, restrictive, and discordant groups.

4.1.11.1 Descriptive and Incidence Rate Analyses

Crude incidence rates of first CJSI were calculated for individuals with ASD and matched individuals without ASD. Incidence rates were defined as the number of first CJSI events divided by the total person-time at risk and were expressed per 1,000 person-years. Person-time was accrued from the index date until the earliest of the following: first CJS involvement, death, loss to follow-up, or the end of the study period.

Incidence rates were estimated for the overall cohort and stratified by age group (childhood, youth, and adulthood). These descriptive analyses were conducted to compare the occurrence of first CJSI between exposure groups and to complement the regression-based analyses.

4.1.11.2 Cox Proportional Hazards Models

The association between ASD and time to first CJSI was examined using Cox proportional hazards models stratified by matched sets to account for the 1:3 matching on age, sex, and RHA.

Covariates included:

- socioeconomic status (SEFI-2),
- maternal immigration status, and
- mental health comorbidities (mood and anxiety disorders and IDD).

Hazard ratios (HRs) and 95% confidence intervals (CIs) were estimated to compare the risk of first CJSI among individuals with ASD and matched individuals without ASD.

Age as the Time Scale

Attained age was used as the time scale in all Cox models to account for the strong and nonlinear relationship between age and CJSI. Individuals entered the risk set at their age at study entry and were followed as they aged throughout the study.

Dynamic Age Group Analyses

Because the likelihood and nature of CJSI vary throughout life course, analyses were conducted within three dynamic age groups:

- Children: 1–11 years
- Youth: 12–17 years
- Adults: ≥ 18 years

Age groups were treated dynamically during follow-up. Individuals contributed person-time to the age group they occupied at a given point in time. For each age-specific analysis, follow-up was restricted to the corresponding age range through left truncation at the lower age boundary and censoring at the upper age boundary.

Separate Cox models were fitted for each age group.

Role-Specific Cox Models

Additional Cox models were fitted to examine associations between ASD and:

- first involvement as an accused person,
- first involvement as a victim, and
- first involvement as a witness.

Role-specific categories were mutually exclusive and were defined according to the individual's role at their first CJSI. As with the primary analyses, separate models were estimated within the child, youth, and adult age groups.

Proportional Hazards Assumption and Model Diagnostics

The proportional hazards assumption was assessed using Schoenfeld residual tests and plots of scaled Schoenfeld residuals.

When the ASD exposure violated the proportional hazards assumption within a specific age group, a time-varying interaction term between ASD and log(time) was added. Model fit was evaluated

using the Akaike Information Criterion (AIC), and the interaction term was retained only if it improved model fit.

4.1.12 Frequency Analyses

To examine the frequency of CJSI among individuals with ASD and matched individuals without ASD, count regression models were used. Outcomes included the total number of CJS contacts and role-specific counts of accused, victim, and witness contacts during follow-up.

The natural logarithm of person-years at risk was included as an offset in all count models to account for differences in follow-up time. This allowed incidence rate ratios (IRRs) to be interpreted as rates of CJS contact per unit of follow-up time and ensured comparability across individuals with varying observation periods.

Poisson regression models were initially fitted; however, substantial overdispersion violated model assumptions. Negative binomial models were subsequently considered, but the high proportion of zero counts (93.65%) resulted in model instability and convergence issues, suggesting that a single process count model was not appropriate for the data.

To account for both overdispersion and excess zeros, zero-inflated negative binomial (ZINB) models were evaluated. The choice between standard negative binomial and ZINB models was based on the distribution of the outcome, model convergence, and model fit statistics, including the Akaike Information Criterion (AIC).

All count models were adjusted for SEFI, maternal immigration status, mood and anxiety disorders, and IDD.

4.1.13 Sensitivity Analyses

Sensitivity analyses were conducted to assess the robustness of the primary findings and evaluate the potential impact of ASD misclassification. Because ASD identification in administrative data depends on the frequency and consistency of recorded diagnoses, several alternative case-identification approaches were examined.

First, all primary analyses were repeated using the relaxed ASD definition. This definition used the same data sources as the primary (restrictive) definition but applied less stringent criteria to Medical Claims data, increasing sensitivity while reducing PPV.

Second, analyses were conducted among individuals who met the relaxed definition but not the restrictive definition. This discordant subgroup represented individuals with possible ASD who did not meet the stricter case-identification criteria, allowing assessment of how diagnostic uncertainty or misclassification might influence the results.

Third, the PHAC ASD case definition was applied as an alternative standardized approach to ASD identification.

Additional sensitivity analyses included the use of conditional logistic regression and the exclusion of mental health comorbidities from the regression models.

These analyses were conducted to determine whether the associations between ASD and CJSI were consistent across alternative case definitions and modelling approaches.

4.2 Results

This chapter presents the findings of the population-based matched cohort study examining whether individuals with ASD had a different risk of CJSI than matched individuals without ASD. The primary analyses were based on the restrictive ASD definition, which was selected because it provided the best balance between diagnostic certainty and case ascertainment. Detailed results for the relaxed ASD definition and the discordant subgroup are presented in the Appendix.

Findings are presented separately for childhood, youth, and adulthood. Two main outcomes were examined: (1) time to first CJSI, overall and by role at first involvement (accused, victim, or witness), and (2) the frequency of CJS contacts, overall and by role.

4.2.1 Cohort Description and Baseline Characteristics

Figure 4.1 illustrates the step-by-step creation of the study cohort using the restrictive ASD definition. Based on this definition, 4,451 individuals with ASD and 13,353 matched individuals without ASD met the eligibility criteria and were included in the primary analyses.

Using the relaxed ASD definition, 6,091 individuals with ASD and 18,273 matched individuals without ASD were identified. The discordant subgroup included 1,640 individuals with ASD and 4,920 matched individuals without ASD.

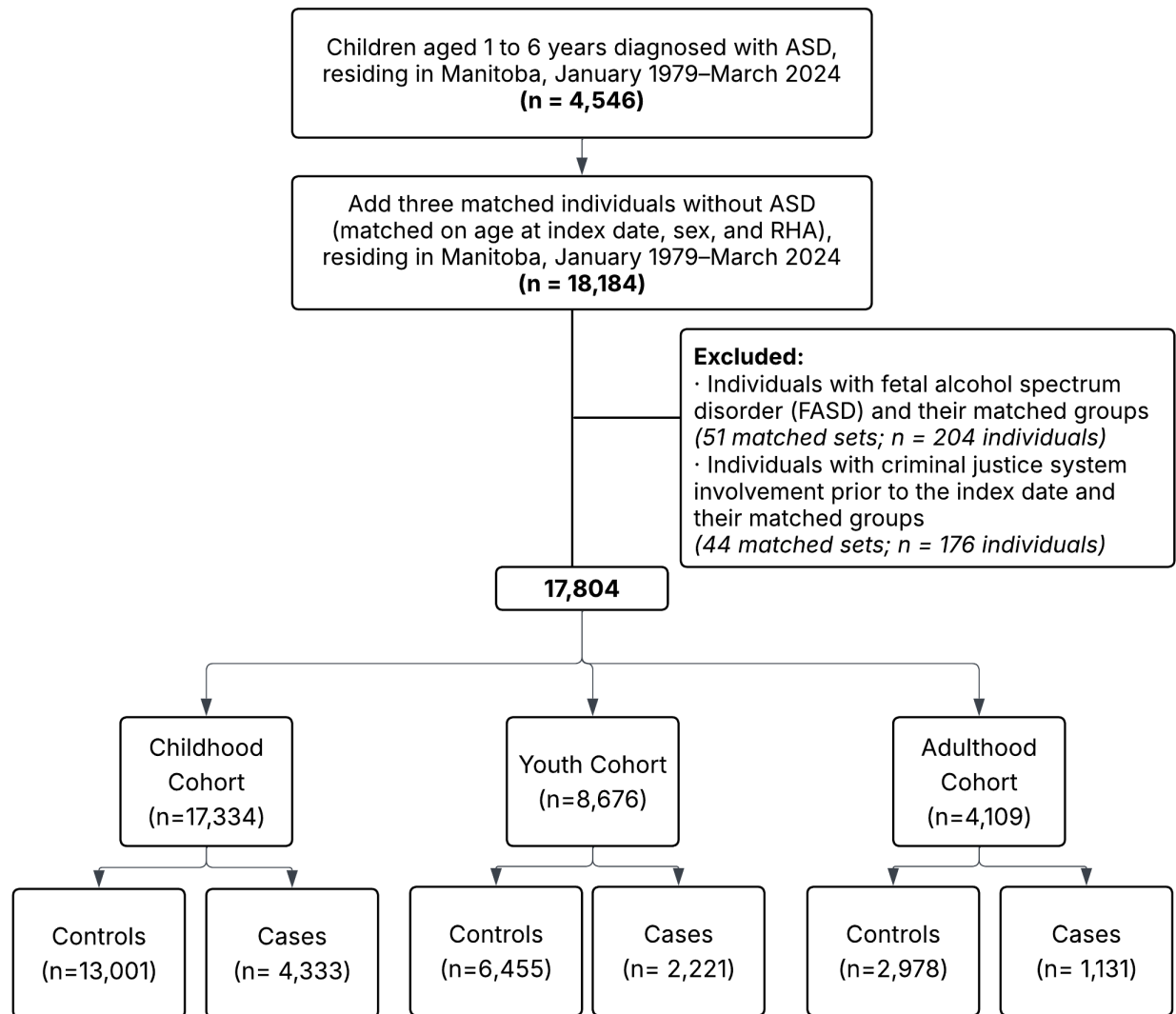


Figure 04.1 Flow diagram of cohort creation for ASD cases and matched controls

The diagram outlines the selection of ASD cases and the matched individuals without ASD, the exclusion of individuals with FASD or prior CJSI, and the creation of childhood, youth, and adult cohorts.

Table 4.1 presents the baseline demographic and clinical characteristics of individuals with ASD identified using the restrictive ASD definition and their matched individuals without ASD. As expected, the matching variables, including age, sex, and RHA, were well balanced between the two groups. This indicates that the matching procedure was successful in creating comparable groups with respect to these characteristics.

However, neighborhood socioeconomic status differed between ASD cases and controls ($p < 0.001$). Individuals with ASD were more often living in areas with higher socioeconomic deprivation compared with the matched controls.

People with ASD had other mental health conditions more often than people without ASD. Mood and anxiety disorders were seen in 17.6% of the ASD group compared to 12.2% of the control group. IDD was present in 8.7% of individuals with ASD, compared to 0.7% of controls. Both differences were statistically significant ($p < 0.001$).

For other characteristics, cases and controls had similar geographic patterns, with about 70% living in urban areas and 30% in rural areas. However, a larger proportion of individuals with ASD had immigrant mothers (30.9%) compared with controls (21.9%), and this difference was statistically significant ($p < 0.001$).

Mean follow-up time differed between individuals with ASD and their matched controls (Table 4.1). Overall, individuals with ASD contributed more person-time to the cohort than controls (mean $\pm$ SD: 10.22 ± 6.38 vs. 9.49 ± 5.97 person-years; $p < 0.001$).

This trend was the same for all developmental stages we had in our study (childhood, adolescence and adulthood). During childhood, people with ASD were followed for a little longer than controls (6.44 ± 2.41 vs. 6.31 ± 2.49 person-years; $p = 0.003$). In adolescence, follow-up time was still slightly higher for those with ASD (4.17 ± 2.10 vs. 4.04 ± 2.10 person-years; $p = 0.010$). In adulthood, the difference was greater, with people with ASD having more person-years of follow-up than controls (7.35 ± 5.70 vs. 6.21 ± 5.24 person-years; $p < 0.001$).

Table 04.1 Baseline characteristics of autistic individuals and matched non-autistic individuals

Variable Type	Restrictive ASD Definition (Algorithm Two)			
	Characteristic	Non-autistic Group (n=13353)	Autistic group (n=4451)	P-value
Matching Variables	Age (mean ± SD)*	3.63± 1.07	3.63± 1.07	0.992
	Sex*			
	-Male	10521 (78.8 %)	3507 (78.8 %)	1.000
	-Female	2832 (21.2 %)	944 (21.2 %)	
	Geographical Location			
	-Rural	3950 (29.6 %)	1317 (29.6 %)	1.000
	-Urban	9403 (70.4 %)	3134 (70.4%)	
	Regional Health Authority*			
	-Interlake-Eastern	942 (7.1 %)	314 (7.1 %)	1.000
	- Northern Health Region	999 (7.5 %)	333 (7.5 %)	
	- Southern Health-Sante Sud	1272 (9.5 %)	424 (9.5 %)	
Covariates	- Prairie Mountain Health	1254 (9.4 %)	418 (9.4 %)	
	- Winnipeg	8886 (66.5 %)	2962 (66.5 %)	
	Neighborhood Socioeconomic Status			
	-Q1 (Lowest)	3156 (23.6 %)	1119 (25.1 %)	<0.001
	- Q2	2794 (20.9 %)	1004 (22.6 %)	
	- Q3	2478 (18.6 %)	872 (19.6 %)	
	- Q4	2499 (18.7 %)	751 (16.9 %)	
	- Q5 (Highest)	2336 (17.5 %)	674 (15.1 %)	
	-Unknown	90 (0.7 %)	31 (0.7 %)	
	Mood and anxiety disorder			
	-Yes	1623 (12.2 %)	782 (17.6 %)	<0.001
	-No	11730 (87.8 %)	3669 (82.4 %)	
	Intellectual developmental disorders			
	-Yes	96 (0.7 %)	389 (8.7 %)	<0.001
	-No	13257 (99.3 %)	4062 (91.3 %)	
	Mother's Immigration Status			
	-Yes	2926 (21.9 %)	1376 (30.9 %)	<0.001
	-No	10303 (77.2 %)	3026 (68.0 %)	
	-Unknown	124 (0.9 %)	49 (1.1 %)	
Duration of Follow-up	Person years of follow up (mean ± SD)			
	-Overall	9.49 ± 5.97	10.22 ± 6.38	<0.001
	-Childhood	6.31 ± 2.49	6.44 ± 2.41	0.003
	-Adolescence	4.04 ± 2.10	4.17 ± 2.10	0.010
	-Adulthood	6.21 ± 5.24	7.35 ± 5.70	<0.001

Characteristics are presented at the index date for individuals with ASD and their matched individuals without ASD. Individuals with ASD and individuals without ASD were matched in a 1:3 ratio on sex, age at index date (±0.5 years), and RHA. Neighborhood socioeconomic status was included as a categorical variable. Mental health comorbidities included mood and anxiety disorders and IDD. Mother's Immigration Status was included as a binary variable. Values are presented as counts (percentages) or medians (interquartile ranges), as appropriate.

*Individuals with ASD and their matched individuals without ASD were matched on sex, age (±0.5 years), and RHA

We accounted for follow-up time differences in our analyses, including incident rate calculations, by using age as the time scale in Cox regression models and by using person-time offsets in count-based models.

4.2.2 Incidence Rate of First Criminal Justice System Involvement

Crude incidence rates of first CJSI differed between individuals with ASD and their matched individuals without ASD in both the overall cohort and the age-specific cohorts (Table 4.2). In the full cohort, the incidence rate was 2.57 per 1,000 person-years of follow-up among individuals with ASD, compared with 8.00 per 1,000 person-years among matched individuals without ASD.

Similar patterns were observed across the age-specific cohorts. In the childhood cohort, the incidence rate was 1.54 per 1,000 person-years for individuals with ASD and 2.94 per 1,000 person-years for matched individuals without ASD. In the youth cohort, the incidence rate was 4.32 per 1,000 person-years for individuals with ASD and 15.6 per 1,000 person-years for matched individuals without ASD. In the adult cohort, the incidence rate was 4.09 per 1,000 person-years for individuals with ASD and 19.3 per 1,000 person-years for matched individuals without ASD.

Overall, individuals with ASD had lower crude incidence rates of first CJSI compared with matched individuals without ASD. These descriptive findings were consistent with the adjusted regression analyses, including the hazard ratios and incidence rate ratios presented in later models, which accounted for differences in follow-up time and other covariates. Incidence rates based on alternative ASD case definitions also showed similar patterns and are presented in Appendix Tables A.8 and A.14.

Table 4.2 Crude incidence rates of first criminal justice system involvement per 1,000 person-years among individuals with ASD and matched individuals without ASD, overall and by age group

Group	People	Events	Person years	Incidence rate per 1,000 PY
Overall				
ASD Case	4451	117	45492	2.57
Non-ASD Match	13353	1013	126655	8.00
Childhood				
ASD Case	4333	43	27905	1.54
Non-ASD Match	13001	241	82050	2.94
Adolescence				
ASD Case	2221	40	9268	4.32
Non-ASD Match	6455	408	26077	15.6
Adulthood				
ASD Case	1131	34	8311	4.09
Non-ASD Match	2978	358	18508	19.3

Incidence rates were calculated by dividing the number of first recorded CJSIs by the total person-years of follow-up. Follow-up began at study entry and ended at the first occurrence of CJSI, death, out-migration from Manitoba, or the end of the study period (March 31, 2025), whichever occurred first. ASD cases were defined using the main ASD definition.

4.2.3 Age-Specific Time to First Criminal Justice System Involvement

We examined the association between ASD and time to first CJSI using Cox proportional hazards regression models, with age used as the time scale. To test whether this association differed across developmental stages, an initial model was fitted using a long-format dataset that included an interaction term between ASD status and age group (childhood, youth, and adulthood). Detailed results for these analyses are provided in the Appendix.

This approach allowed participants to experience their person time in a different age group and go from one to another as they age.

The interaction between ASD and age group was statistically significant, showing that the relationship between ASD and CJSI was affected by developmental stages. As a result, separate

models were run for each age group: childhood (1-11), youth (12 to 17 years), and adulthood (18 years and older).

The proportional hazards assumption was checked for all models; when violated, a time-varying effect model was added.

Table 04.3 Age-specific associations between ASD and time to first criminal justice system involvement using the restrictive ASD definition

Variables	Children (1–11 years) HR (95% CI)	Youth (12–17 years) HR (95% CI)	Adults (≥18 years) HR (95% CI)
ASD (ref: control)			
Crude	0.51 (0.37–0.71)	0.28 (0.20–0.38)	0.23 (0.16–0.33)
Adjusted	0.51 (0.36–0.73)	0.29 (0.20–0.43)	0.33 (0.21–0.50)
SEFI (per unit increase)	1.71 (1.40–2.08)	1.50 (1.28–1.77)	1.20 (0.99–1.46)
Mood and anxiety disorder	1.35 (0.87–2.07)	1.39 (1.08–1.81)	1.18 (0.89–1.55)
Intellectual developmental disorders	2.14 (0.96–4.7)	0.76 (0.41–1.41)	0.32 (0.14–0.71)
Immigrant mother	0.35 (0.21–0.60)	0.49 (0.28–0.84)	0.29 (0.12–0.69)

Hazard ratios (HRs) were calculated using Conditional Cox proportional hazards regression models with age used as the time scale. The models were stratified by matched sets and adjusted for SEFI, maternal immigration status, mood and anxiety disorders, and IDD. Matched individuals without ASD were used as the reference group.

Table 4.3 shows the hazard ratios for time to first CJSI using the main ASD definition. It compares individuals with ASD to their matched individuals without ASD in different age groups.

Individuals with ASD had a significantly lower risk of first CJS involvement compared to matched individuals without ASD, in all age groups.

Among children, individuals with ASD had a slightly lower risk of CJSI compared with matched individuals without ASD (Adjusted Hazard Ratio [Adj HR]: 0.51, 95% Confidence Interval [CI]: 0.36–0.73).

This association was strongest during adolescence. Youth with ASD had the lowest relative risk of first CJS involvement compared with matched individuals without ASD (Adj HR: 0.29, 95% CI: 0.20–0.43).

In adulthood, individuals with ASD continued to have a lower risk of CJSI than matched individuals without ASD (Adj HR: 0.33, 95% CI: 0.21–0.50).

The crude and adjusted hazard ratios were similar, indicating that the covariates had minimal impact on the results. The sensitivity analyses also demonstrated the robustness of these findings. The relaxed ASD definition showed estimates in the same direction, although with smaller magnitudes. However, results from the discordant group were weaker and less precise due to smaller sample size (Appendix Tables A.9, and A.15).

4.2.4 Age- and Role-Specific Time to First Criminal Justice System Involvement

To examine whether the association between ASD and CJSI varied by type of contact, separate age-specific Conditional Cox proportional hazards models were fitted for first CJSI as an accused person, a victim, and a witness.

Children were not included in the accused models because they are not legally held criminally responsible.

Three cohorts were created based on attained age during follow-up: childhood (1–11 years), youth (12–17 years), and adulthood (≥ 18 years). Conditional Cox proportional hazards models were used to examine time to first CJSI within each cohort and across each role in the first involvement (e.g., accused, victim, or witness). Individuals contributed person-years only while they were within the age range defined for each cohort.

The role-specific analyses showed differences in CJSI patterns across age groups (Table 4.4).

Table 4.4 Age- and role-specific hazard ratios for first CJSI among individuals with ASD compared with matched individuals without ASD.

Role at first CJS contact	Children(1–11years) HR (95% CI)		Youth (12–17 years) HR (95% CI)		Adults (≥18 years) HR (95% CI)	
	Crude	Adjusted	Crude	Adjusted	Crude	Adjusted
Accused	—	—	0.17 (0.09–0.30)	0.17 (0.08–0.34)	0.13 (0.07–0.25)	0.23 (0.12–0.44)
Victim	0.61 (0.43–0.87)	0.61 (0.41–0.89)	0.38 (0.21–0.65)	0.36 (0.19–0.69)	0.41 (0.21–0.79)	0.64 (0.27–1.48)
Witness	0.26 (0.11–0.60)	0.26 (0.10–0.64)	0.38 (0.21–0.68)	0.47 (0.24–0.94)	0.32 (0.16–0.63)	0.34 (0.15–0.79)

Separate conditional Cox proportional hazards models were fitted to examine first CJSI as an accused person, victim, or witness within dynamic age-specific cohorts: childhood, youth, and adulthood. Age was used as the time scale in all analyses. Both crude and adjusted estimates were reported. The models were stratified by matched sets and adjusted for SEFI, maternal immigration status, mood or anxiety disorders, and IDD. Criminal accusations were not examined in the childhood cohort because children cannot be legally charged with crimes.

4.2.4.1 First Involvement as Accused

For accused involvement, individuals with ASD had a substantially lower risk than matched individuals without ASD in both youth (Adj HR: 0.17, 95% CI: 0.08–0.34) and adulthood (Adj HR: 0.23, 95% CI: 0.12–0.44).

4.2.4.2 First Involvement as Victim

Across all age groups, individuals with ASD had a lower risk of victim involvement compared with matched individuals without ASD; however, the strength of this association varied by age group. During childhood, individuals with ASD had a lower risk of victim involvement than matched individuals without ASD (Adj HR: 0.61, 95% CI: 0.41–0.89). In youth, individuals with ASD also had a significantly lower risk of victim involvement (Adj HR: 0.36, 95% CI: 0.19–0.69). In adulthood, the adjusted results suggested a weaker association compared with adolescence, and

the confidence interval for the adjusted estimate included the null value (Adj HR: 0.64, 95% CI: 0.27–1.48). However, the crude estimates were stronger in the same direction and remained statistically significant (Crude HR: 0.41, 95% CI: 0.21–0.79).

4.2.4.3 First Involvement as Witness

Like victim and accused involvement, individuals with ASD also had a lower hazard of witness involvement across all age groups. The association between ASD and witness-related CJSI was strongest during childhood (Adj HR: 0.26, 95% CI: 0.10–0.64). In the youth cohort, the hazard ratio estimates were weaker but statistically significant (Adj HR: 0.47, 95% CI: 0.24–0.94), and in adulthood, they remained lower (Adj HR: 0.34, 95% CI: 0.15–0.79).

Overall, the results from the analyses by age group and role for time to first CJSI were similar in the sensitivity analyses. When the relaxed ASD definition was used, hazard ratios showed the same direction of association but slightly weaker magnitudes across age groups. Results from the discordant group were also weaker and less precise than those obtained using the main and relaxed ASD definitions, likely because of the smaller sample size (Appendix Tables A7, A8, and A13).

4.2.5 Frequency of Criminal Justice System Involvement

4.2.5.1 Overall Frequency of Criminal Justice System Involvement

We used zero-inflated negative binomial regression models to compare the number of CJSI in individuals with ASD and their matched individuals without ASD. Based on these analysis results, people with ASD had substantially lower rates of CJSI compared with matched individuals without ASD in all the count outcomes, including the total CJS contacts or by each role. For total CJS contacts across all roles, individuals with ASD showed clearly lower rates of involvement. After

adjusting for SEFI, maternal immigration status, mood and anxiety disorders, and IDD, individuals with ASD had a 91% lower rate of CJSI compared with matched individuals without ASD (Adj HR: 0.09, 95% CI: 0.06–0.37).

Table 4.5 Frequency of criminal justice system involvement among individuals with ASD compared with matched individuals without ASD

Count outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)
Total CJS contacts (any role)	0.12 (0.09–0.17)	0.09 (0.06–0.37)
Accused contacts	0.06 (0.04–0.10)	0.02 (0.01–0.04)
Victim contacts	0.28 (0.19–0.40)	0.27 (0.18–0.40)
Witness contacts	0.16 (NA–NA)	0.15 (0.09–0.24)

Incidence rate ratios (IRRs) were calculated using zero-inflated negative binomial regression models to handle overdispersion and the large number of zero CJS contacts. The models included a negative binomial part for the count data and a logistic part, with only an intercept, to account for excess zeros. Follow-up time was included by using the log of person-years as an offset. Crude models included only ASD status, while adjusted models controlled for SEFI, maternal immigration status, mood and anxiety disorders, and IDD. Matched individuals without ASD were used as the reference group.

4.2.5.2 Role-Specific Frequency of Criminal Justice System Involvement

Like the findings for overall CJSI frequency across any role, role-specific analyses of the number of CJSIs within each role showed lower rates among individuals with ASD compared with matched individuals without ASD across all roles (Table 4.5). However, the largest difference was seen for accused contacts. Individuals with ASD had a 98% lower rate compared to controls (Adj HR: 0.02, 95% CI: 0.01–0.04).

Victim and witness roles similarly experienced a lower incident rate ratio of CJSI in individuals with ASD compared to their matched individuals without ASD.

The crude and adjusted results of the frequency analyses showed overall the same patterns. In all cases, adjusting for the covariates strengthened the association. This can suggest that the covariates

did not confound the results. Overall, these findings complement the findings from time-to-event analyses. These results indicate that not only did individuals with ASD have a lower risk of first CJSI, but they also experienced fewer repeated contacts during the follow-up period.

4.2.6 Model Diagnostics

The proportional hazards assumption in the Cox models was evaluated using Schoenfeld tests and residual plots for time-dependent effects. In most models, there was no evidence of violation of this assumption. More specific details can be found in the Appendix.

4.2.7 Sensitivity Analyses Using Alternative ASD Case Definitions

We did sensitivity analyses to test the robustness of the main findings when we use different definitions of ASD. In addition to the primary restrictive case definition (Algorithm 2), all analyses were repeated using a relaxed definition (Algorithm 1). We also conducted analyses in a discordant subgroup comprising individuals who met the relaxed criteria but did not meet the restrictive definition.

As an additional robustness check, conditional logistic regression models were used as an alternative analysis to directly account for the matched study design.

We used the same matching process, follow-up definitions, age-specific cohorts, and covariate adjustments in all sensitivity analyses, as in the main analysis. Results of sensitivity analyses for time to first CJSI, the number of CJS contacts, and the conditional logistic regression models are presented here with more complementary tables in the Appendix chapter.

4.2.7.1 Relaxed Algorithm (Algorithm 1)

This definition identified a larger, less diagnostically consistent group than the restrictive definition. The findings for the incidence rates were in the same direction as the analyses using the main definition, although the magnitude of the associations was slightly smaller.

Using the relaxed ASD definition generally yielded smaller-magnitude hazard ratios for time to first CJSI than the main definition. This pattern was observed in childhood, youth, and adulthood. The estimates were slightly closer to the null but remained in the same direction as the main analysis.

The results from the zero-inflated negative binomial models were the same as those for the time to first CJSI. These results showed slightly weaker associations between ASD and CJS contact frequency when the relaxed definition was used. However, the direction of the estimates was consistent with the primary analysis.

Overall, the result from the relaxed definition supports the main findings. It can also be concluded that using a more restrictive ASD definition could lead to stronger observed associations by reducing exposure misclassification.

Baseline characteristics of ASD cases and matched controls identified using the relaxed definition are presented in Appendix Table A.7.

4.2.7.2 Discordant Group

A discordant group is defined as individuals who meet the relaxed definition but not the restrictive one. Effect estimates for this group were generally weaker. The incidence rate estimates had smaller magnitudes and greater variability, but they were mostly in the same direction, except during childhood.

In most age- and role-specific Cox models, the hazard ratios were closer to 1.0 than those from main or relaxed definition. The confidence intervals were wide and often included 1.0. A similar pattern was seen for the incidence rate ratios from the zero-inflated negative binomial models.

The weaker associations seen in the discordant group are likely due to differences in how ASD was identified in these individuals. People in this group often had fewer or less consistent administrative indicators of ASD, which may have resulted in greater variation in the findings.

Overall, these results suggest that, regarding CJSI, this group was more similar to the matched individuals without ASD than to those identified using the other ASD definitions.

The results from the discordant group suggest that exposure misclassification is more likely than a true causal association with ASD-related risk. Stronger associations were seen with the restrictive definition, intermediate estimates with the relaxed definition, and weaker associations in the discordant group. This pattern supports the main findings and shows how diagnostic certainty can influence the size of observed effects.

Crude incidence rates using the relaxed ASD definition and the discordant group are summarized in Appendix Tables A.8 and A.14. Detailed hazard ratio estimates from the age-specific and role-specific Cox models are presented in Appendix Tables A.9, A.10, and A.15. Appendix Tables A.11 and A.16 show the incidence rate ratios from the zero-inflated negative binomial models for the restrictive and discordant groups.

Together, these tables provide the full set of sensitivity analysis results that support the summary findings described above.

4.2.7.3 Conditional logistic regression

To account for the matched study design, a sensitivity analysis using conditional logistic regression was performed. ASD case status was the main exposure, and any criminal justice system involvement during follow-up was the outcome.

In these models, individuals with ASD had significantly lower odds of CJSI compared to matched individuals without ASD. The estimates were derived from both the crude (Crude OR: 0.27, 95% CI: 0.21–0.33) and adjusted (Adjusted OR = 0.31, 95% CI: 0.24–0.39) models. After adjusting for the covariates, the association remained statistically significant.

4.2.7.4 Using an Alternative ASD Case Definition (Public Health Agency of Canada)

As an additional sensitivity analysis, we applied the autism case definition developed for the Canadian Chronic Disease Surveillance System and reported by the Public Health Agency of Canada (PHAC)(65). This definition identifies autism among children and youth aged 1–19 years as either at least one hospitalization with an autism-related diagnostic code or two or more physician claims with such codes. In our study, we applied this definition to children aged 1 to 6 years. This analysis was conducted to assess the robustness of our findings using an external case definition. Application of this definition resulted in the identification of 1,612 ASD cases and 4,836 matched controls. The maximum age of individuals identified under this definition was 14.34 years; therefore, analyses were restricted to childhood and youth cohorts, and no adult cohort was available.

Overall, individuals with ASD identified using the PHAC definition had a lower crude incidence rate of CJSI compared to matched individuals without ASD (1.26 vs. 2.17 per 1,000 person-years).

In age-specific analyses, a limited number of events were observed. Within the childhood cohort, 73 individuals with ASD were identified, of whom 57 had victim involvement and 16 had witness involvement. The hazard ratios suggested lower risks of overall involvement in childhood (HR = 0.54), as well as lower risks for both victim (HR = 0.61) and witness involvement (HR = 0.25) among children with ASD compared to controls; however, none of these estimates were statistically significant.

In the youth cohort, no CJS events were observed among individuals with ASD, precluding estimation of hazard ratios. A total of 769 matched controls were included in this age group.

Overall, analyses based on the PHAC ASD definition were limited by small sample size and sparse event counts, resulting in reduced statistical power and imprecise estimates. However, the direction of association for available estimates remained consistent with the primary analyses.

4.2.7.5 Excluding Intellectual developmental disorders and Mood and Anxiety Disorders

Other sensitivity analyses were conducted to examine the result of removing IDD and mood and anxiety disorders from the Cox regression models. Adjustment for mental health comorbidities (mood and anxiety disorders and IDD) did not meaningfully change the estimated association between ASD and CJSI.

In childhood, removing these covariates resulted in a slightly weaker association (adjusted HR changed from 0.51 to 0.56). However, the direction and statistical significance remained the same. In youth, the hazard ratio remained identical after exclusion (HR = 0.29), which means IDD and mood and anxiety disorders did not affect the results in this group.

In adults, removing IDD and mood and anxiety disorders made the association stronger (the hazard ratio changed from 0.33 to 0.23). This suggests that these comorbid conditions may explain part

of the difference in CJSI among adults with ASD. Overall, conclusions about the lower CJSI among individuals with ASD were robust to the removal of these variables.

4.3 Discussion

4.3.1 Criminal Justice System Involvement among Individuals with ASD

This longitudinal cohort study is the first in Canada to use linked administrative health and justice data to examine CJSI among autistic individuals across multiple roles, including accused persons, victims, and witnesses, compared with matched individuals without ASD. Overall, autistic individuals were less likely to experience CJSI than matched individuals without ASD. This pattern was observed consistently across childhood, adolescence, and adulthood, as well as across all justice-system roles examined.

Similar findings were observed in the frequency analyses, with autistic individuals experiencing lower rates of repeated CJS involvement than matched individuals without ASD. Sensitivity analyses using alternative ASD case definitions and modelling approaches produced similar results, supporting the robustness of the findings.

4.3.1.1 Overall Criminal Justice System Involvement

The finding that autistic individuals were less likely to experience CJSI than matched individuals without ASD is consistent with several recent population-based and systematic-review studies (19,36,45,66–68). These findings contrast with some earlier studies that reported higher rates of justice system involvement among autistic individuals (13,15,16,69).

Although some researchers have suggested that certain characteristics associated with ASD may increase the likelihood of behaviors that could lead to justice system contact (14), other studies have reported that autistic individuals often demonstrate relatively low offending rates and may be more likely to follow rules and routines that help them navigate social situations (45,68). These characteristics may contribute to lower rates of CJSI in some settings.

A review by Dell’Osso et al. further highlighted that the common media narrative portraying autistic individuals as more likely to commit crimes is not supported by current evidence (8). Such narratives may contribute to stigma and negative societal attitudes toward autistic individuals and their families. The authors noted that many widely publicized criminal cases provide little or no confirmed evidence of an ASD diagnosis and that, even when ASD is present, these cases represent only a very small proportion of autistic individuals overall (8). Consequently, media portrayals may create a misleading impression regarding the relationship between ASD and criminal behavior.

Our findings add to the growing body of population-based evidence suggesting that autistic individuals are not overrepresented in the justice system. Rather, when examined using linked administrative data and compared with a similar group of individuals without ASD, autistic individuals appear to have lower levels of CJSI across multiple stages of life.

4.3.1.2 Role-Specific Criminal Justice System Involvement as Accused

When examining specific roles within the CJS, individuals with ASD were substantially less likely to be involved as accused persons than matched individuals without ASD. The largest differences were observed during adolescence and adulthood.

One possible explanation relates to differences in developmental trajectories and levels of supervision. Adolescence is typically associated with increasing independence, expanded peer networks, and greater exposure to environments in which CJSI may occur. However, this transition may differ for individuals with ASD. Research suggests that although adolescents with ASD often gain independent living and daily functioning skills, progress may occur more gradually and may plateau in adulthood (70,71). Consequently, many autistic individuals continue to receive substantial family support and supervision throughout adolescence and adulthood (72,73). This increased supervision may reduce exposure to situations associated with offending or other forms of CJSI, although this relationship has not been directly examined in the cited studies.

4.3.1.3 Role-Specific Criminal Justice System Involvement as Witness

The findings for witness involvement were consistent with the overall pattern of lower CJSI among individuals with ASD. However, the available literature on witness involvement remains limited, making direct comparisons difficult. Existing studies have generally focused on offending or victimization, with relatively little attention paid to autistic individuals as witnesses within the justice system. Some research suggests that autistic individuals may experience interactions with the CJS across multiple roles, including victim, suspect, and witness roles, although findings remain mixed and inconclusive (74,75). Additional research is needed to better understand witness involvement among autistic individuals and the factors that may influence these interactions.

4.3.1.4 Role-Specific Criminal Justice System Involvement as Victim

The findings regarding victimization differed from much of the existing literature. Previous studies have reported high levels of victimization among individuals with ASD and, in many cases, higher victimization rates than those observed among individuals without ASD (21–25,76). In contrast,

children with ASD in our study experienced lower levels of victimization than matched individuals without ASD.

One possible explanation for this discrepancy is differences in how victimization was measured. Most previous studies assessed victimization using questionnaires or surveys completed by autistic individuals, parents, caregivers, or teachers (21,23–25,46). These studies often captured a broad range of experiences, including bullying, teasing, emotional abuse, and other adverse events that may never come to the attention of law enforcement. In contrast, our study measured victimization using police-reported incidents recorded in the PRISM dataset. As a result, the two approaches may capture different aspects of victimization and are not directly comparable.

Differences in study design may also contribute to the inconsistent findings reported in the literature. Previous studies have frequently relied on relatively small samples and a wide variety of methodologies, making comparisons across studies difficult (17,45). Variations in study populations, outcome definitions, and data sources may further contribute to differences in reported victimization rates.

Another explanation relates to the nature of the administrative justice data used in this study. The PRISM dataset captures only incidents that come to the attention of police and are formally recorded within the justice system. Victimization that is not reported to police, is resolved informally, or is addressed through schools, families, healthcare providers, or community services would not be captured. Consequently, our findings reflect police-reported victimization rather than the broader range of victimization experiences examined in many questionnaire-based studies.

There are also reasons why some autistic individuals and their caregivers may be reluctant to involve law enforcement. For example, Crane et al. reported that fewer than 20% of interactions

between autistic individuals and law enforcement officers in England and Wales were perceived as satisfactory (77). Similarly, a Canadian study found that many autistic individuals described negative experiences with police, leading to feelings of fear and distrust that could discourage future reporting of incidents or requests for assistance (78). If victimization is less likely to be reported to police, administrative justice data may underestimate the true burden of victimization experienced by autistic individuals.

4.3.2 Frequency of Criminal Justice System Contacts

In addition to lower rates of time to first CJSI across all roles (victim, witness, and accused), individuals with ASD also experienced lower rates of CJS contact over the follow-up period.

Research examining the frequency of CJS contact remains limited (21,79), and few studies have simultaneously considered multiple roles within the justice system. Consequently, the present study addresses an important gap in literature by examining the frequency of CJS contact as an accused person, victim, and witness within a single population-based cohort.

The largest difference was observed for accused-related involvement, with individuals with ASD experiencing substantially lower rates of accused-related CJS contacts than matched individuals without ASD. This finding is consistent with previous research suggesting that autistic youth are not more likely to reoffend than their peers (79). However, because the present analyses examined counts of accused-related CJS contacts rather than recidivism, direct comparisons with studies of reoffending should be made with caution.

Although victim-related contacts were more common than accused-related contacts within the ASD group, rates remained lower than those observed among matched individuals without ASD. This finding appears to contrast with the results reported by Pfeffer et al. (21), who found high

levels of victimization among children with ASD, including multiple victimization experiences. However, that study examined the prevalence of victimization within an ASD sample and did not compare victimization rates with a population-based comparison group. In addition, the study relied on questionnaire-based measures of victimization, which capture a broader range of experiences than police-recorded incidents.

Overall, these findings provide further evidence that ASD is not associated with increased rates of CJSI and suggest that autistic individuals may experience lower levels of justice system contact across multiple roles. At the same time, differences between administrative-data studies and questionnaire-based studies highlight the need for future research that integrates administrative, survey, and self-report data to better understand the full spectrum of CJSI among autistic individuals.

4.3.3 Sensitivity Analyses

Sensitivity analyses were conducted to evaluate the robustness of the primary findings and to assess the potential impact of ASD misclassification. Overall, the results were consistent across alternative ASD case definitions and analytical approaches.

First, all analyses were repeated using the relaxed ASD definition (Appendix Tables A.7- A.11). Although the associations were generally weaker in magnitude, the direction of the findings remained unchanged. This pattern is consistent with the expectation that the relaxed definition may include individuals with less certain ASD diagnoses and therefore be more susceptible to misclassification. Such misclassification would be expected to attenuate associations toward the null.

Second, analyses were conducted using the discordant subgroup (Appendix Tables A.14- A.16). Estimates from these analyses were substantially closer to the null than those observed in the primary analyses, providing additional evidence that diagnostic certainty influences the strength of the observed associations.

Third, conditional logistic regression models that accounted for the matched study design produced findings similar to those from the primary conditional Cox models. Individuals with ASD consistently showed lower odds of CJSI than matched individuals without ASD, further supporting the robustness of the findings.

Fourth, sensitivity analyses were conducted using the PHAC ASD case definition. The results were generally consistent with those obtained using the primary definition. However, because the PHAC definition relies primarily on administrative health records, it may fail to identify individuals whose ASD diagnoses were captured only through education or clinical datasets. The relatively small number of identified cases and the absence of events within some age groups suggest that reliance on health administrative data alone may not be sufficient for studies examining rare outcomes.

Finally, removing mental health comorbidities from the regression models did not materially alter the findings. Although the magnitude of some estimates changed slightly, the direction and statistical significance of the associations remained consistent. These results suggest that the observed relationship between ASD and CJSI was robust to the inclusion or exclusion of mental health comorbidities as defined in this study.

Overall, the consistency of findings across multiple case definitions, analytical approaches, and model specifications supports the robustness of the study results.

Chapter 5. Overall Discussion

5.1 Overview of the Thesis Findings

This thesis examined two related questions: how ASD can be accurately identified using administrative data and how individuals with ASD interact with the CJS across the life course. Using linked population-based data from Manitoba, the thesis first evaluated the validity of administrative ASD case definitions and then applied the validated definition in a cohort study examining CJSI.

The validation study demonstrated that administrative data can be used with reasonable confidence to identify ASD in young children, although the performance of the algorithms varied. The relaxed definition showed higher sensitivity and identified a larger proportion of clinically confirmed ASD cases, whereas the restrictive definition showed a substantially higher positive predictive value (PPV), indicating greater diagnostic certainty. Because minimizing exposure misclassification was a priority for the cohort study, the restrictive definition was selected as the primary ASD case definition, while the relaxed definition was retained for sensitivity analyses.

Using this validated ASD definition, the cohort study found that individuals with ASD had consistently lower rates of CJSI than matched individuals without ASD. This pattern was observed across childhood, youth, and adulthood and remained consistent across multiple analytical approaches. Lower involvement was observed both in analyses of time to first CJSI and in analyses examining the frequency of CJS contacts. Furthermore, lower rates of involvement were observed across all justice-system roles examined, including involvement as an accused person, a victim, and a witness.

The restrictive ASD case definition was selected because it provided greater diagnostic certainty and a higher positive predictive value, thereby reducing the likelihood of false-positive ASD classification. However, its lower sensitivity means that some individuals with ASD may have been misclassified as non-ASD (false negatives). Such non-differential exposure misclassification would be expected to attenuate the estimated associations by biasing them toward the null. Despite this potential bias, the study consistently observed statistically significant protective associations between ASD and criminal justice system involvement, suggesting that the true associations may be at least as strong as, or potentially stronger than, those reported.

The findings challenge the common perception that individuals with ASD are at increased risk of involvement in the justice system. Instead, within this population-based cohort, individuals with ASD were observed to have lower levels of police-recorded CJSI than matched individuals without ASD. These findings were robust across multiple sensitivity analyses, including alternative ASD case definitions and different statistical approaches.

Sensitivity analyses also highlighted the importance of ASD case ascertainment in administrative data research. Although the direction of the associations remained consistent across alternative ASD definitions, the magnitude of the associations varied. Analyses using the relaxed definition produced weaker associations, while analyses of the discordant subgroup yielded estimates closer to the null. These findings suggest that diagnostic certainty can influence the strength of observed associations and reinforce the importance of validating administrative case definitions before examining population-level outcomes.

Overall, this thesis demonstrates the value of linked administrative data for studying long-term outcomes among individuals with ASD and the importance of rigorous case identification. More

importantly, it provides new population-based evidence that, in this cohort, individuals with ASD were observed to have lower rates of police-recorded criminal justice system involvement than matched individuals without ASD.

Because this was an observational study, these findings should not be interpreted as establishing or excluding a causal relationship between ASD and criminal justice system involvement.

5.2 Strengths of the Thesis

This thesis has several important strengths. First, it used linked, population-based administrative data from the Manitoba Population Research Data Repository. These datasets contain information from multiple sectors, including healthcare, clinical services, education, and the justice system, and cover nearly the entire provincial population. The use of population-level data reduces selection bias and allows outcomes to be examined across a large population over an extended period.

Second, the thesis incorporated a validation study before conducting the cohort analysis. Many studies that use administrative data rely on previously published case definitions without assessing their performance in the study population. In contrast, this thesis evaluated ASD case definitions against clinically confirmed diagnoses from Manitoba clinical datasets. This approach increased confidence in the identification of ASD cases and strengthened the validity of the cohort study findings.

Third, the cohort study used a matched design. Each individual with ASD was matched to three individuals without ASD based on sex, age, and Regional Health Authority. This approach

improved the comparability of the study groups and reduced the potential influence of important demographic differences on the observed associations.

Fourth, the study accounted for the strong relationship between age and CJSI in two complementary ways. Attained age was used as the time scale in the survival analyses, and separate analyses were conducted for childhood, youth, and adulthood. This approach allowed age-specific patterns of CJSI to be examined across different stages of life.

Fifth, this study examined multiple forms of CJSI, including involvement as an accused person, victim, and witness. Most previous studies have focused primarily on offending behavior or a single justice-system role. By examining multiple roles simultaneously, this thesis provides a more comprehensive understanding of how autistic individuals interact with the justice system.

Finally, several sensitivity analyses were conducted to evaluate the robustness of the findings. These analyses included alternative ASD case definitions, alternative statistical approaches, and models excluding mental health comorbidities. The consistency of results across these analyses strengthens confidence in the main study findings.

5.3 Limitations of the Thesis

Despite these strengths, several limitations should be considered when interpreting the findings of this thesis.

First, administrative data are collected primarily for service delivery and administrative purposes rather than research. Consequently, diagnostic information recorded in these datasets may not always perfectly reflect clinically confirmed conditions. Although the validation study

demonstrated reasonable performance of the ASD case definitions, some degree of misclassification may remain.

Second, the clinical datasets used as the reference standard in the validation study, including RCC and CDS, do not capture all children with ASD in Manitoba. Some children may receive diagnoses through other clinical pathways and therefore may not be represented in these datasets.

Third, ASD diagnoses often occur after developmental concerns first emerge. As a result, administrative records may not fully capture the timing of early developmental difficulties, which could lead to delays in identifying ASD within administrative datasets.

Fourth, although the cohort study adjusted for several relevant covariates, including SEFI, maternal immigration status, and mental health comorbidities, other potentially important factors were not available in the administrative data. These may include family characteristics, social support, adverse childhood experiences, and other environmental influences. The absence of such variables may have resulted in residual confounding.

Finally, CJSI was measured using records from the PRISM dataset, which captures police-reported incidents recorded within the provincial justice system. Consequently, the study did not capture incidents that were not reported to police, were resolved informally, or were addressed through schools, families, healthcare providers, or community organizations. The findings therefore reflect police-recorded CJSI and may not represent the full range of victimization, offending, or justice-related experiences examined in questionnaire-based or self-report studies.

5.4 Advancement of Knowledge

This thesis contributes to existing literature in several important ways.

First, it provides evidence on the validity of identifying ASD using administrative data in Manitoba. By comparing two administrative algorithms with clinically confirmed diagnoses, the study demonstrated that administrative data can be used to identify ASD with reasonable accuracy. The findings also highlight the trade-off between sensitivity and PPV when selecting ASD case definitions and emphasize the importance of validating administrative algorithms before using them in population-based research.

Second, this thesis provides new population-based evidence on the relationship between ASD and CJSI in Canada. Using linked administrative data and a matched cohort design, the study found that individuals with ASD experienced lower rates of CJSI than matched individuals without ASD. These findings contribute to a growing body of evidence suggesting that autistic individuals are not overrepresented in the justice system and challenge common assumptions regarding ASD and justice-system involvement.

Third, this study extends the existing literature by examining multiple justice-system roles. Much of the previous research has focused primarily on offending behavior or involvement as an accused person. In contrast, this thesis examined CJSI across three distinct roles: accused person, victim, and witness. This broader approach provides a more comprehensive understanding of how autistic individuals interact with the justice system and highlights important differences across types of involvement.

Fourth, this thesis adopts a life-course perspective by examining CJSI separately during childhood, youth, and adulthood. Previous studies have often focused on a single age group or have not explicitly examined how justice-system involvement varies across different stages of life. By incorporating age-specific analyses and using attained age as the time scale, this study provides new evidence regarding patterns of CJSI across the life course among individuals with ASD.

Finally, the findings demonstrate that the choice of ASD case definition can influence the magnitude of associations observed in administrative data research. Comparisons across the restrictive, relaxed, and discordant ASD definitions showed that diagnostic certainty affects the strength of observed associations. These findings reinforce the importance of careful case ascertainment when studying population-level outcomes using administrative data.

Together, these contributions advance both the methodological and substantive literature on ASD. They improve understanding of ASD identification in administrative data and provide new evidence regarding justice-system involvement among autistic individuals across multiple roles and stages of life.

5.5 Implications for Research and Policy

The findings of this thesis have several implications for research, policy, and practice.

From a research perspective, the results highlight the importance of validating case definitions when using administrative data to study ASD and long-term outcomes. The findings demonstrate that different ASD case definitions can influence the strength of observed associations and reinforce the need for careful case ascertainment in population-based research. The study also

illustrates the value of linked administrative data for examining outcomes across multiple sectors, including healthcare, education, and the justice system.

From a policy perspective, the findings challenge the common perception that individuals with ASD are at increased risk of involvement in the justice system. Across childhood, youth, and adulthood, individuals with ASD experienced lower rates of police-recorded CJSI than matched individuals without ASD. These findings suggest that policies and public discussions surrounding ASD should be guided by population-based evidence rather than assumptions or isolated high-profile cases.

The findings may also have implications for autistic individuals and their families. Public narratives sometimes portray autistic individuals as being at increased risk of offending or justice-system involvement. The results of this study do not support this perception and instead suggest that autistic individuals are not overrepresented in the justice system. Providing accurate information may help reduce stigma and alleviate concerns among families regarding future justice-system involvement.

For practitioners working in healthcare, education, social services, and the justice system, the findings highlight the importance of avoiding assumptions about elevated offending risk based solely on an ASD diagnosis. Instead, assessments and interventions should focus on individual circumstances, strengths, and support needs rather than generalized perceptions of risk.

Finally, the findings suggest that policy efforts may be more effectively directed toward improving access to diagnostic services, developmental support, transition services, and programs that promote well-being and social inclusion. Given the evidence of lower police-recorded CJSI among

individuals with ASD, policies that focus primarily on criminality or offending risk may be less informative than those aimed at supporting positive developmental and social outcomes across the life course.

5.6 Directions for Future Research

Several directions for future research emerge from the findings of this thesis.

First, future studies should examine outcomes that occur after CJSI among individuals with ASD. Although the present study focused on the occurrence and frequency of CJSI, less is known about the consequences of justice-system contact for autistic individuals. Future research could examine subsequent health outcomes, mental health service use, hospitalizations, substance use, educational attainment, employment, and other social outcomes following CJSI, and compare these trajectories with those of individuals without ASD.

Second, additional research is needed to better understand justice-system trajectories among individuals with ASD. While this study examined overall involvement and role-specific contacts, future studies could investigate subsequent stages of justice-system involvement, including court appearances, sentencing outcomes, diversion programs, and case resolution. Such research could help identify whether autistic individuals experience different pathways through the justice system after initial contact.

Third, further investigation of victimization among individuals with ASD is warranted. The findings of this thesis differed from many questionnaire-based studies that have reported high levels of victimization among autistic individuals. Future research integrating administrative, survey, and self-report data could help clarify whether these differences reflect variations in

measurement, reporting practices, or the types of victimization being captured. Such work may provide a more complete understanding of victimization experiences among autistic individuals across the life course.

Fourth, future studies could benefit from incorporating additional linked administrative datasets to better understand the social and environmental factors associated with CJSI. For example, linkage with child welfare records, income assistance data, disability support programs, housing services, and other social-sector datasets may provide valuable insights into factors that influence justice-system involvement and long-term outcomes among individuals with ASD.

Finally, future research could examine how the timing of ASD diagnosis influences later outcomes. Earlier identification of ASD may improve access to services and supports, potentially affecting developmental trajectories, educational experiences, social outcomes, and interactions with the justice system over time.

Together, these research directions would help build a more comprehensive understanding of the life-course experiences of individuals with ASD and the factors that influence their interactions with health, social, educational, and justice systems.

5.7 Conclusion

This thesis examined both the identification of ASD in administrative data and the relationship between ASD and CJSI in Manitoba. The validation study demonstrated that administrative data can be used to identify ASD with reasonable accuracy and highlighted the trade-offs between sensitivity and PPV when selecting case definitions.

Using the validated ASD definition, the cohort study found that individuals with ASD consistently experienced lower rates of CJSI than matched individuals without ASD. This pattern was observed across childhood, youth, and adulthood, across multiple justice-system roles, including accused, victim, and witness involvement, and across a range of sensitivity analyses. These findings contrast with common public perceptions and some earlier studies suggesting elevated justice-system involvement among autistic individuals.

The findings also demonstrated that the choice of ASD case definition influenced the magnitude of the observed associations, emphasizing the importance of rigorous case ascertainment when using administrative data. Nevertheless, the direction of the findings remained consistent across alternative ASD definitions and analytical approaches, supporting the robustness of the results.

Overall, this thesis provides new population-based evidence indicating that ASD is not associated with increased CJSI and may be associated with lower levels of justice-system contact across multiple stages of life. In addition to advancing methodological knowledge regarding ASD identification in administrative data, this research contributes to a broader understanding of justice-system involvement among autistic individuals and highlights the value of linked population-based data for studying long-term outcomes across health, education, and justice sectors.

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A. Appendix

This appendix includes additional analysis results for different autism spectrum disorder (ASD) case definitions and checks that support the results presented in Results section of Chapter 4.

A.1 Primary Analyses Checks

A.1.1 Cox model including interaction between ASD and age group (Main Analyses)

To formally test whether the relationship between ASD and criminal justice system (CJS) involvement differed by developmental stage, we used a long-format dataset in a Cox proportional hazards model. This model included an interaction between ASD status and age group. The model was stratified by matched set and adjusted for socioeconomic status, maternal immigration status, mood and anxiety disorders, and intellectual disability. The interaction term for childhood was statistically significant, showing that the association varied by age group. The age-specific estimates from this interaction model are like those from the separate age-specific Conditional Cox models.

Table A.1 Cox proportional hazards model with interaction between ASD and age group (long-format dataset)

Variable	Exponentiation of the Coefficient	95% CI	p-value
ASD (adult group; reference = control)	0.25	0.17–0.38	3.21e-11
Age group: youth	—	—	—
Age group: child	—	—	—
ASD × youth	1.22	0.74–2.03	0.4306
ASD × child	2.26	1.34–3.80	0.0020
SEFI (per unit increase)	1.46	1.31–1.62	1.04e-12
Mood/anxiety disorder	1.30	1.09–1.55	0.0023
Intellectual disability disorders	0.73	0.48–1.11	0.1427
Maternal immigration status	0.39	0.27–0.55	7.30e-08

Exponentiation of the Coefficients were estimated using a Conditional Cox proportional hazards model with age as the time scale [coxph(formula = Surv(start_long, stop_long, event_long) ~ group * age_group + strata(grpID), data = long_data)]. The model was fitted to a long-format dataset and included an interaction term between ASD status and age group (childhood, youth, adulthood). The model was stratified by matched set to account for the matched study design and adjusted for socioeconomic status (SEFI), maternal immigration status, mood and anxiety disorders, and intellectual disability. The adult age group and matched controls served as the reference categories. Interaction terms represent departures from the ASD effect observed in adulthood. Age-specific hazard ratios presented in the main text were derived from separate age-stratified Cox models rather than directly from this interaction model.

Table A.2 Calculated Hazard Ratio of total criminal justice system involvement using Cox model with interaction between ASD and age group (long-format dataset)

Age Group	Adjusted Hazard Ratio (HR)	95% CI
Adult	0.25	0.17–0.38
Youth	0.30	0.22–0.44
Child	0.57	0.40–0.80

Conditional Cox proportional hazards model with age as the time scale using the long format data and interaction between age group and ASD. The adult group was as the reference group, and child and youth group hazard ratios were calculated based on that.

A.2 Cox Model Diagnostics for Primary Analyses

The proportional hazards assumption in the Cox models was evaluated using Schoenfeld tests and residual plots for time-dependent effects. In most models, there was no evidence of violation of this assumption. In some cases, the overall test indicated a violation of the proportional hazard assumption, but the test for individual variables for ASD did not. In these cases, the important result was for the ASD variable estimates for the assumption check, as it is the main variable in our study. When the overall test showed a violation of the assumption, but the ASD variable showed no evidence of non-proportionality, the non-proportionality was because of other variables that could not affect the ASD result.

In the youth cohort, testing of the proportional hazards (PH) assumption for overall criminal justice system involvement showed a statistically significant result for the ASD variable based on the Schoenfeld residual test ($p = 0.0052$). However, visual inspection of the Schoenfeld residual plot did not show a clear or consistent time-related pattern (Figure A.1).

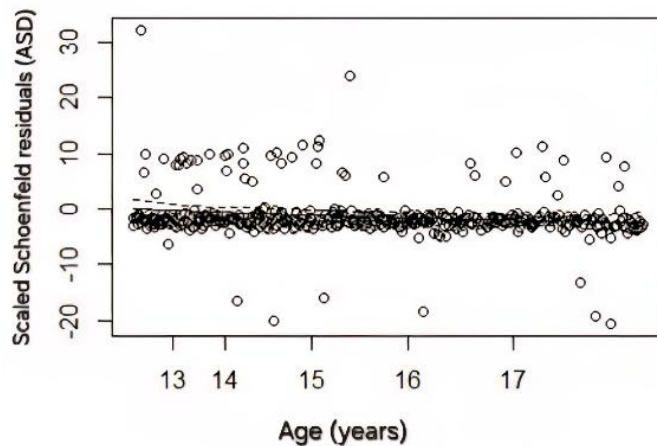


Figure A.1 Assessment of the Proportional Hazards Assumption for ASD Using Schoenfeld Residuals (Youth Cohort)

Schoenfeld residuals for the ASD variable were plotted against attained age in the youth cohort. The Schoenfeld test showed statistical evidence of non-proportional hazards for the ASD variable ($p = 0.0052$). However, visual inspection did not show a clear or consistent time-related trend over time.

To further assess possible non-proportionality, an extended Cox model with a time-dependent interaction term for ASD was fitted, and the result of this analysis is summarized in Table A.3. Model comparison using the Akaike Information Criterion (AIC) showed only a small improvement for the time-varying model ($\Delta\text{AIC} = 5$). Because there were no clear visual trend and only limited improvement in model fit, the standard proportional hazards model was kept for simplicity and easier interpretation.

For transparency, the hazard ratio for ASD over time from the extended model is shown in Figure A.2.

Table A.3 Parameter estimates from the time-varying Cox proportional hazards model for time to first criminal justice system involvement in the youth cohort.

Variable	HR	P_Value
ASD (reference = control)	$2.092e^{+04}$	0.01629
Time varying of ASD	$1.624e^{-02}$	0.00743

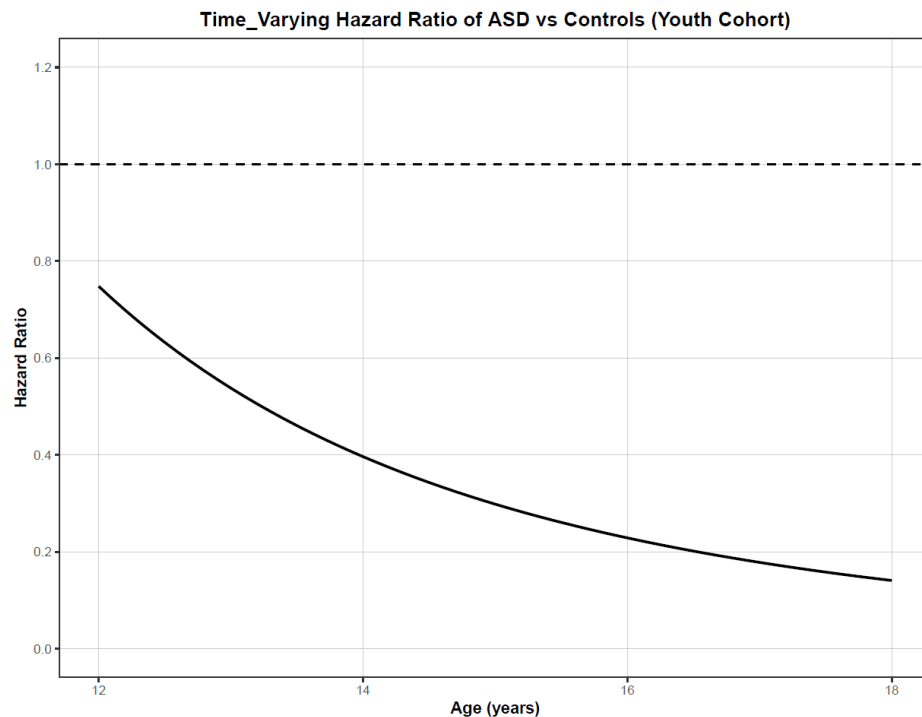


Figure A.2 Estimated Time-Varying Hazard Ratio for ASD and Overall Criminal Justice System Involvement (Youth Cohort)

The figure shows the estimated hazard ratio (HR) for ASD compared with controls over attained age, based on an extended Cox model that included a time-dependent interaction term for ASD. The dashed horizontal line represents $HR = 1.0$, which indicates no association.

Although the extended model showed a small improvement in model fit ($\Delta AIC = 5$), the proportional hazards model was kept because it is simpler and easier to interpret.

For involvement as a witness in the youth cohort, the Schoenfeld residual test showed statistical evidence of non-proportional hazards for the ASD variable ($p = 0.027$). However, visual inspection of the Schoenfeld residual plot did not show a clear or consistent time-related pattern (Figure A.3).

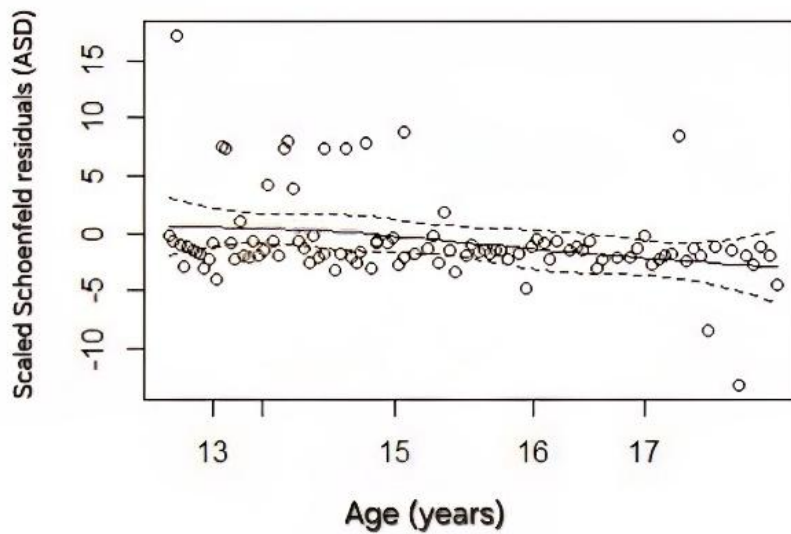


Figure A.3 Assessment of the Proportional Hazards Assumption for Witness Involvement for ASD Using Schoenfeld Residuals (Youth Cohort)

Scaled Schoenfeld residuals for the ASD variable were plotted against attained age for involvement as a witness in the youth cohort. The Schoenfeld test showed statistical evidence of non-proportional hazards ($p = 0.027$). However, visual inspection did not show a clear or consistent change in the effect over time.

To further examine this possible violation, an extended Cox model with a time-dependent interaction term for ASD was fitted. Model comparison using the AIC showed a much poorer fit for the time-varying model (AIC = 978) compared with the standard proportional hazards model (AIC = 247). Because there was no clear visual trend and the model fit was substantially worse, the proportional hazards model was kept.

For transparency, the estimated hazard ratio for ASD over time from the extended model is shown in Figure A.4.

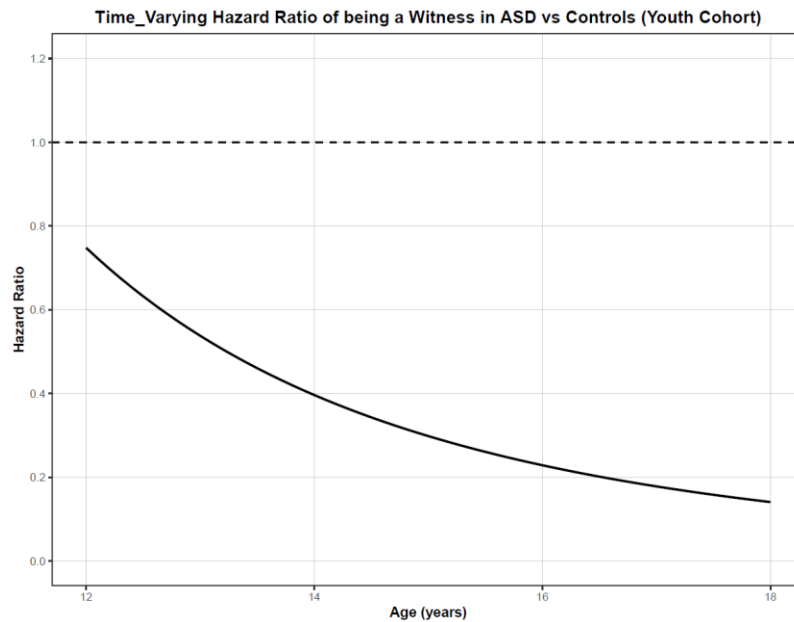


Figure A.4 Estimated Time-Varying Hazard Ratio for ASD and Witness Involvement (Youth Cohort)

The figure shows the hazard ratio for ASD cases compared with matched controls over attained age during adolescence. This hazard ratio was calculated using an extended Cox model with a time-dependent interaction term for ASD. The dashed horizontal line indicates no association (HR=1).

A.2.1 Count Model Diagnostics for Primary Analyses

To choose an appropriate count regression model, we first examined the distribution of criminal justice system contact counts. Descriptive statistics showed that the variance was much larger than the mean. They also showed that many individuals had no contact during follow-up. Together, these patterns indicated overdispersion and zero inflation.

Table A.4 summarizes key distributional characteristics of total CJSI counts.

Table A.4 Descriptive Statistic for total criminal justice system contacts

Statistic	Value
Mean count	0.27
Variance	5.21
Median	0
Minimum	0

Statistic	Value
Maximum	85
Proportion with zero contacts	93.6 %
Proportion with ≥ 1 contact	6.3 %
N (total individuals)	17804

This table presents a distributional summary of total criminal justice system contact counts, including the mean, variance, median, minimum, maximum, and proportion of zero counts.

Table A.5 summarizes the distribution of CJSI counts. Figure A.5 illustrates the distribution of total contact counts, which is characterized by substantial right skewness and a high frequency of zero counts. To provide a clearer view of the non-zero observations, Figure A.6 displays the distribution of total CJSI counts ranging from 1 to 20.

Table A.5 Counts of CJSI Distribution

Counts of CJSI	Frequency	Percent
0	16674	93.65
1	553	3.11
2	195	1.10
3	92	0.52
4	61	0.34
5	41	0.23
6	20	0.11
7	23	0.13
8	22	0.12
9	9	0.05
10 +	114	0.64



Figure A.5 Histogram of Total CJSI Counts during follow-up

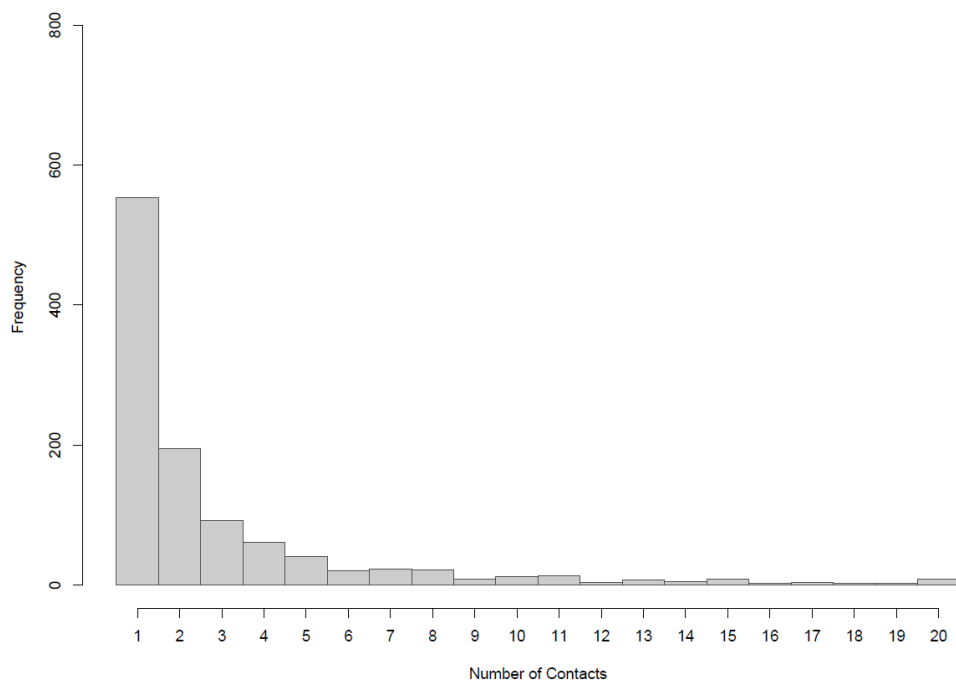


Figure A.6 Histogram of Total CJSI Counts during follow-up (Values 1 to 20)

A diagnostic review was carried out for the count models (Table A.6). Poisson regression showed strong overdispersion, with the variance much larger than the mean. Standard negative binomial models were also tested, but they did not converge because of numerical instability. Zero-inflated negative binomial models converged successfully and caused the best fit to the data. This was expected because many counts were zero, and only a small group of individuals had frequent events.

Table A.6 Summary of model convergence and diagnostic evaluation for Poisson, Negative Binomial, and Zero-Inflated Negative Binomial (ZINB) models

Model Type	Convergence	Overdispersion	Zero Inflation	Notes
Poisson	Converged	Dispersion ratio = 215.22 ($p < 0.001$)	Not modeled	Severe overdispersion; poor fit
Negative Binomial	Failed	Not applicable	Not modeled	Numerical divergence; model unstable
Zero-Inflated Negative Binomial (ZINB)	Converged	Appropriately handled	Explicitly modeled	Best-fitting model; stable estimates

Based on the model diagnostic test, there was overdispersion in the Poisson regression, which means that the mean was greater than the variance, so the standard negative binomial models were fitted, but due to failure to converge, we switched to zero-inflated negative binomial (ZINB) models, which successfully converged and were able to appropriately account for excess zeros, provided the best fit to the data, and were used in our analyses.

A.3 Sensitivity Analysis Using Relaxed ASD Case Definition

This section presents the results of the sensitivity analyses conducted using a relaxed ASD definition and on the discordant group. The analyses for these two groups are the same as those for the restrictive definition of ASD as the min analyses. In this section, we present results from age- and role-specific Conditional Cox proportional hazards models and zero-inflated negative binomial models for the frequency of criminal justice system involvement.

A.3.1 Baseline Characteristics (Relaxed Algorithm)

This section presents the baseline characteristics of ASD cases and their matched controls when the relaxed definition was used.

In Table A.7, baseline characteristics are shown for individuals identified as having ASD using the relaxed case definition and for their matched controls. This definition required at least one ASD-related physician claims record, or an ASD-related record from a hospitalization, education file, the Rehabilitation Centre for Children (RCC), or Children's disABILITY Services (CDS). Cases and controls were matched by age at the index date, sex, and Regional Health Authority (RHA). Categorical variables are reported as counts and percentages. Continuous variables are reported as means with standard deviations.

Table A.7 Baseline characteristics of ASD cases and matched controls using the relaxed definition

Variable Type	Characteristic	Control Group (n=18273)	ASD group (n=6091)	P-value
Matching Variables	Age (mean $\pm$ SD) *	3.79 $\pm$ 1.15	3.79 $\pm$ 1.15	0.992
	Sex*			1.000
	-Male	14325 (78.4 %)	4775 (78.4 %)	
	-Female	3948 (21.6 %)	1316 (21.6 %)	
	Geographical Location*			
	Rural	5701 (31.2 %)	1899 (31.2 %)	0.987
	Urban	12572 (68.8 %)	4192 (68.8 %)	
	Regional Health Authority*			1.000
	-IE (Interlake-Eastern)	1308 (7.2 %)	436 (7.2 %)	
	- NO (Northern Health Region)	1446 (7.9 %)	482 (7.9 %)	
	- SO (Southern Health-Sante Sud)	1842 (10.1 %)	614 (10.1 %)	
Covariates	- WE (Prairie Mountain Health)	1785 (9.8 %)	595 (9.8 %)	
	- WP (Winnipeg RHA)	11892 (65.1 %)	3964 (65.1 %)	
	Neighborhood Socioeconomic Status			<0.001
	-Q1 (Lowest)	4318 (23.6 %)	1535 (25.2 %)	
	- Q2	3832 (21.0 %)	1368 (22.5 %)	
	- Q3	3422 (18.7 %)	1193 (19.6 %)	
	- Q4	3411 (18.7 %)	1009 (16.6 %)	
	- Q5 (Highest)	3178 (17.4 %)	947 (15.5 %)	
	- NF	112 (0.6 %)	39 (0.6 %)	
	Mood and anxiety disorder			
	Yes	2323 (12.7 %)	1134 (18.6 %)	<0.001

Variable Type	Characteristic	Control Group (n=18273)	ASD group (n=6091)	P-value
	No	15950 (87.3 %)	4957 (81.4 %)	
	Intellectual developmental disorders			
	Yes	143 (0.8 %)	536 (8.8 %)	<0.001
	No	18130 (99.2 %)	5555 (91.2 %)	
	Mother's Immigration Status			
	Yes	3919 (21.4 %)	1685 (27.7 %)	<0.001
	No	14180 (77.6 %)	4338 (71.2 %)	
	Not Available	174 (1.0 %)	68 (1.1 %)	
	Person years of follow up (mean $\pm$ SD)			
	Overall	9.62 $\pm$ 6.10	10.29 $\pm$ 6.50	<0.001
	Childhood	6.22 $\pm$ 2.46	6.31 $\pm$ 2.42	0.015
	Adolescence	4.10 $\pm$ 2.09	4.22 $\pm$ 2.09	0.005
	Adulthood	6.37 $\pm$ 5.24	7.48 $\pm$ 5.74	<0.001

Characteristics are presented at the index date for individuals with ASD and their matched controls. Cases and controls were matched in a 1:3 ratio on sex and age at index date (± 0.5 years), and the Regional Health Authority. Socioeconomic status was measured using the Socioeconomic Factor Index (SEFI). Mental health comorbidities include mood and anxiety disorders and intellectual disability. Values are presented as counts (percentages) or medians (interquartile ranges), as appropriate. *Cases and controls were matched on sex, age (± 0.5 years), and Regional Health Authority.

A.3.2 Incidence of First Criminal Justice System Involvement (Relaxed Algorithm)

Although the incident was consistent with the main analyses and the rate of ASD cases was much lower than that of their matched controls, the absolute rates were higher than those in the main analysis, which may indicate greater diagnostic certainty under the restrictive definition (Table A.8).

Table A.8 Crude Incidence rates of first criminal justice system involvement per 1,000 person years among individuals with ASD and matched controls, overall and by age group (Algorithm 1)

Cohort	Group	People	Events	Person years	Incidence rate per 1,000 PY
Overall	ASD	6091	221	62697	3.52
	Control	18273	1485	175749	8.45
Childhood	ASD	5900	78	37215	2.10
	Control	17701	326	110068	2.96
Adolescence	ASD	3131	74	13205	5.60
	Control	9182	609	37626	16.20
Adulthood	ASD	1640	69	12265	5.63
	Control	4401	543	28027	19.40

Incidence rates were calculated by dividing the number of first recorded criminal justice system events by the total person-years of follow-up. Follow-up time was defined as the time from cohort entry to the first occurrence of an criminal justice involvement event, death, out-migration from the province, or the end of the study period (March 31, 2025). ASD cases were identified using the less restrictive administrative case definition (Algorithm 1).

A.3.3 Age-Specific Time to First Criminal Justice System Involvement (Relaxed Algorithm)

The same analyses performed for the main analyses using the restrictive definition of ASD were repeated using the relaxed definition. Conditional Cox models were fitted with age as the timescale, and separate models were fitted for different age groups. The models were also stratified by matched sets and were adjusted for the covariates, including socioeconomic status (SEFI), maternal immigration status, mood and anxiety disorders, and intellectual disability.

The results of these sensitivity analyses were consistent with the main analyses. These results remained in the same direction but with a smaller magnitude when the relaxed ASD case definition was used (Table A.9)

Table A.9 Adjusted age-specific hazard ratios for the association between ASD and time to first criminal justice system involvement

Variable	Children (1–11 years) HR (95% CI)	Youth (12–17 years) HR (95% CI)	Adults (≥18 years) HR (95% CI)
ASD (ref: control)			
Crude	0.71 (0.55–0.91)	0.34 (0.27–0.44)	0.31 (0.24–0.40)
Adjusted	0.67 (0.51–0.88)	0.35 (0.26–0.46)	0.39 (0.29–0.52)
SEFI (per unit increase)	1.77 (1.49–2.10)	1.46 (1.28–1.67)	1.17 (1.01–1.37)
Mood/anxiety disorder	1.34 (0.94–1.91)	1.43 (1.16–1.76)	1.30 (1.05–1.63)
Intellectual developmental disorders	2.03 (1.08–3.81)	0.89 (0.57–1.40)	0.37 (0.21–0.66)
Maternal immigration status	0.33 (0.21–0.54)	0.37 (0.22–0.59)	0.43 (0.25–0.73)

Hazard ratios (HRs) were calculated using Conditional Cox proportional hazards regression models with age used as the time scale. The models were stratified by matched sets and adjusted for socioeconomic status (SEFI), maternal immigration status, mood and anxiety disorders, and intellectual disability. Matched controls were used as the reference group.

A.3.4 Age- and Role-Specific Time to First Criminal Justice System Involvement (Relaxed Algorithm)

As a sensitivity analysis, age- and role-specific associations between ASD and time to first CJS involvement were examined using Conditional Cox proportional hazard models with a relaxed ASD definition.

Overall, the results were consistent in direction with the main results, with hazard ratios smaller in magnitude (closer to 1.0). The confidence interval was slightly narrower in the relaxed ASD sample definition, due to the larger number of ASD cases identified under this definition.

Table A.10 Age- and role-specific hazard ratios for time to first criminal justice system involvement among individuals with ASD compared with matched controls

Role at first CJS contact	Children (1–11 years) HR (95% CI)	Youth (12–17 years) HR (95% CI)	Adults (≥18 years) HR (95% CI)
Accused			
Crude	—	0.26 (0.18–0.38)	0.20 (0.14–0.31)
Adjusted	—	0.25 (0.16–0.39)	0.30 (0.20–0.47)
Victim			
Crude	0.88 (0.67–1.16)	0.48 (0.32–0.73)	0.57 (0.36–0.89)
Adjusted	0.83 (0.61–1.12)	0.45 (0.27–0.74)	0.57 (0.32–1.01)
Witness			
Crude	0.30 (0.16–0.58)	0.38 (0.23–0.62)	0.35 (0.20–0.60)
Adjusted	0.30(0.15–0.60)	0.46 (0.26–0.81)	0.40 (0.21–0.76)

Separate Conditional Cox proportional hazards models were fitted to examine first involvement as an accused, a victim, or a witness within dynamic age-specific cohorts: childhood (under 12 years), youth (13 to 17 years), and adulthood (18 years and older). Age was used as the time scale in the analysis. Crude and adjusted estimations were reported. The models were stratified by matched sets and adjusted for socioeconomic status (SEFI), maternal immigration status, mood or anxiety disorders, and intellectual disability. We did not include criminal accusations in childhood since children cannot be legally charged with crimes.

A.3.5 Frequency of Criminal Justice System Involvement (Relaxed Algorithm)

This sensitivity analysis tested whether the associations between ASD and the frequency of CJSI remained consistent when using a more relaxed ASD definition that required one or more medical claims records for ASD.

Table A.11 Frequency of criminal justice system involvement among individuals with ASD compared with matched controls

Count outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)
Total CJS contacts (any role)	0.24 (0.19–0.31)	0.16 (0.12–0.21)
Accused contacts	0.16 (0.11–0.24)	0.07 (0.04–0.10)
Victim contacts	0.43 (0.32–0.57)	0.41 (0.30–0.55)
Witness contacts	0.22 (0.15–0.31)	0.18 (0.12–0.27)

Incidence rate ratios (IRRs) were calculated using zero-inflated negative binomial regression models to handle overdispersion and the large number of zero CJS contacts. The models included a negative binomial part for the count data and a logistic part, with only an intercept, to account for excess zeros. Follow-up time was included by using the log of person-years as an offset. Crude models included only ASD status, while adjusted models controlled for socioeconomic status (SEFI), maternal immigration status, mood and anxiety disorders, and intellectual disability. Matched controls were used as the reference group.

The results from the role-specific analyses using the relaxed ASD case definition provided evidence of the robustness of the main findings. The result has the same general pattern in the same direction but smaller in magnitude than the main analyses using a restrictive definition. This suggests that the restrictive ASD case definition relies on more precise recorded diagnoses. This method of ASD definition likely reduces misclassification and produces stronger effect estimates and clearer differences between individuals with ASD and matched controls.

A.3.6 Model Diagnostics for Models with Relaxed Algorithm

We used the same diagnostic checks used in the main analyses for the sensitivity analyses. These sensitivity analyses were done using the relaxed ASD case definition and the discordant group. For time dependence, the Schoenfeld residual tests were used to examine the proportional hazards assumption. When violations occurred, models with time-varying effects were fitted.

A.3.6.1 Proportional Hazards Diagnostics for Relaxed Definition of ASD Case Definition

In this sample of people with ASD and their matched controls, the proportional assumption was tested for all models, and most showed no violation. However, in two of these models, the Schoenfeld test showed p-values less than 0.05, yet the Schoenfeld residual did not show a clear pattern. Then we tested the model fit using AIC, and for any involvement in the youth cohort, there

was a small improvement in fit (2 scores), which is not that high. And for the victimization in the adult cohort, the model fit was poor when we used a time-varying model. Therefore, we kept the result from the regular conditional Cox model as our main result, but reported the results from the diagnostic checks, plots, and time-varying hazard ratio visualization based on the time-varying model for any involvement in the youth cohort.

Figures A.7 and A.8 display Schoenfeld residual plots for ASD status in the youth cohort for any criminal justice system involvement and in the adult cohort for victimization outcomes, respectively.

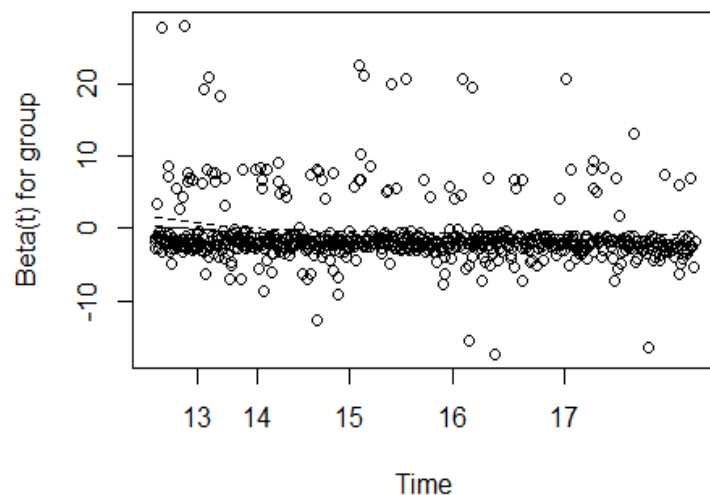


Figure A.7 Schoenfeld residual plot for ASD status in the youth cohort Cox model for time to first criminal justice system involvement, demonstrating evidence of non-proportional hazards

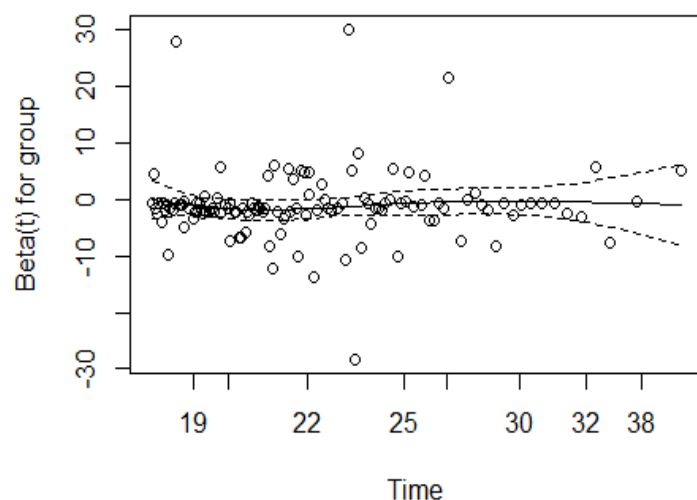


Figure A.8 Schoenfeld residual plot for ASD status in the adult cohort Cox model for victimization outcomes, indicating minor departures from proportional hazards

A.3.6.2 Model Fit Comparison for Standard vs. Time-Varying Cox Models

To evaluate whether violations of the proportional hazard assumption warranted use of a time-varying effect for ASD, AIC values were compared for the standard Cox model and a Cox model including an interaction between ASD status and log-transformed time. Lower AIC values indicate better model fit.

Table A.12 AIC comparison for standard and time-varying Cox proportional hazards models

Cohort & Outcome	Standard Cox AIC	Time-Varying Cox AIC	Preferred Model	Rationale
Youth – Any CJS involvement	1507.732	1505.012 (lower)	Time-varying	ASD violated PH; TV improved fit
Adult – Victimization	283.2546	1200.4003 (higher)	Standard Cox	Time-varying did not improve fit

To compare which model performs better, an AIC test was conducted on the youth cohort, where any movement is examined, and on the adult cohort in the victim role-specific model, and the decision was made based on the test results.

Based on the results in Table A.12, the time-varying Cox model provided a slightly better fit. Despite this small improvement in fit when time-varying model was used, the regular conditional

Cox model was selected for reporting to facilitate interpretation. For adult victimization, there was some evidence that the ASD effect was not proportional over time. However, the time-varying model fits the data less well. For this reason, the standard Conditional Cox model was kept.

A.3.6.3 Time-Varying Cox Model for Youth Cohort

The Standard Conditional Cox proportional-hazards model was selected for reporting over the time-varying model. This selection was based on the lack of a clear pattern of disproportionate residuals in the Schoenfeld Residual plot, only a small improvement in model fit based on AIC for the time-varying model, and the similarity of interpretation when the standard model is used.

However, the Conditional Cox proportional hazards model with a time-varying effect for ASD was fitted by including an interaction between ASD status and log-transformed time. The result of this model is summarized in Table A.13. In addition, Figure A.9 displays the hazard ratio for criminal justice involvement comparing individuals with ASD to their matched controls as they age. This pattern shows that the association between ASD and criminal justice system involvement weakened over the adolescent years.

Table A.13 Parameter estimates from the time-varying Cox proportional hazards model for time to first criminal justice system involvement in the youth cohort

Variable	HR	P_Value
ASD (reference = control)	325.96793	0.06429
Time varying of ASD	0.08089	0.02956

A time-varying Cox model was used to account for non-proportional hazards for ASD by including an interaction between ASD status and log(time). The main ASD HR represents the effect at the reference time, and the time-varying term captures changes in this association over age. Models were adjusted for covariates and stratified by matched sets.

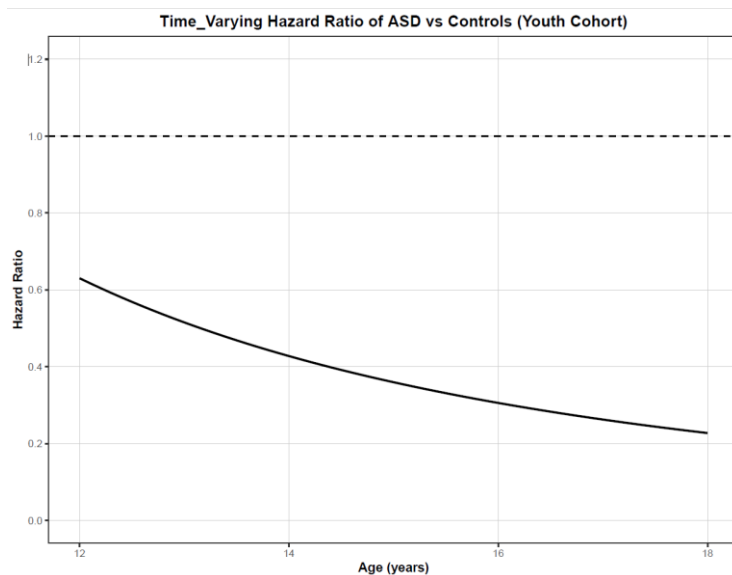


Figure A.9 Estimated age-varying hazard ratio comparing individuals with ASD to matched controls in the youth cohort

A.4 Sensitivity Analysis Using Discordant Group

This section presents the results of sensitivity analyses using the discordant group. A discordant group is a group of people who have been identified as having ASD based on the relaxed algorithm but do not have an ASD record under a restrictive definition of ASD.

A.4.1 Incidence of First Criminal Justice System Involvement (Discordant group)

The discordant group's incident rates were closer to those of the matched controls, indicating greater diagnostic uncertainty within this subgroup.

Table A.14 Crude Incidence rates of first criminal justice system involvement per 1,000 person-years among individuals with ASD and matched controls, overall and by age group (Discordant group)

Group	People	Events	Person years	Incidence rate per 1,000 PY
Overall				
ASD	1640	104	17204	6.04
Control	4290	472	49094	9.61
Childhood				
ASD	1567	35	9310	3.76
Control	4701	85	28018	3.03

Group	People	Events	Person years	Incidence rate per 1,000 PY
Adolescence				
ASD	910	34	3937	8.64
Control	2728	201	11550	17.4
Adulthood				
ASD	509	35	3954	8.85
Control	1424	185	9519	19.4

Incidence rates were calculated by dividing the number of first recorded criminal justice system events by the total person-years of follow-up. Follow-up time was defined as the time from entry into the study cohort until the first event, death, out-migration from the province, or the end of the study period (March 31, 2025), whichever came first. ASD cases were defined as individuals who had an ASD record under the relaxed definition but did not meet the criteria under the restrictive definition.

A.4.2 Age- and Role-Specific Time to First Criminal Justice System Involvement

(Discordant group)

Another sensitivity analysis was done using the discordant group, and the results are presented in Table A.15. This group has people who have a less certain ASD diagnosis.

Age- and role-specific analyses were conducted for this group, and the analytical approach was identical to that used in the main analysis.

In these analyses, discordant groups showed weaker associations. Although most of the point estimates stayed under 1.0 and suggested the lower hazard of criminal justice involvement in individuals with ASD, many of the estimations were not significant, especially in childhood and for victim and witness roles.

Table A.15 Age- and role-specific associations between ASD and time to first criminal justice system involvement using discordant group

Role at first CJS contact	Children (1–11 years) HR (95% CI)	Youth (12–17 years) HR (95% CI)	Adults (≥18 years) HR (95% CI)
Any Involvement			
Crude	1.31 (0.88–1.97) *	0.48 (0.33–0.70)	0.47 (0.32–0.68)
Adjusted	1.10 (0.71–1.70) *	0.45 (0.29–0.70)	0.47 (0.31–0.71)
Accused			
Crude	—	0.41 (0.25–0.70)	0.35 (0.20–0.60)
Adjusted	—	0.38 (0.20–0.69)	0.39 (0.22–0.71)
Victim			
Crude	1.89 (1.20–2.98) *	0.75 (0.39–1.44) *	0.83 (0.43–1.60) *
Adjusted	1.54 (0.93–2.52) *	0.63 (0.28–1.43) *	0.57 (0.25–1.28) *

Role at first CJS contact	Children (1–11 years) HR (95% CI)	Youth (12–17 years) HR (95% CI)	Adults (≥18 years) HR (95% CI)
Witness			
Crude	0.39 (0.13–1.11) *	0.37 (0.14–0.95)	0.42 (0.17–1.04) *
Adjusted	0.33 (0.10–1.03) *	0.43 (0.15–1.17) *	0.50 (0.18–1.39) *

Separate Conditional Cox proportional hazards models were fitted to examine first involvement as an accused, a victim, or a witness within dynamic age-specific cohorts: childhood (under 12 years), youth (12 to 17 years), and adulthood (18 years and older). Age was used as the time scale in the analysis. Crude and adjusted estimations were reported. The models were stratified by matched sets and adjusted for socioeconomic status (SEFI), maternal immigration status, mood or anxiety disorders, and intellectual disability. We did not include criminal accusations in childhood since children cannot be legally charged with crimes. ASD cases were defined as people who had an ASD record based on the relaxed ASD definition but did not have an ASD record under the restrictive one. * Not Significant.

A.4.3 Frequency of Criminal Justice System Involvement (Discordant group)

To more deeply analyze the results of using different ASD case definitions in our study, the discordant group was used to examine the frequency of criminal justice involvement under this definition.

The discordant group showed less consistent and weaker estimates than algorithms 1 and 2. This may be due to greater variability and less certainty in the ASD case definition in the discordant group. It also shows the importance of how we define ASD in our study.

Table A.16 Frequency of criminal justice system involvement among individuals with ASD compared with matched controls

Count outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)
Total CJS contacts (any role)	0.51 (0.33–0.79)	0.28 (0.19–0.43)
Accused contacts	0.36 (0.20–0.65)	0.16 (0.09–0.29)
Victim contacts	0.92 (0.55–1.53) *	0.79 (0.48–1.30) *
Witness contacts	0.41 (0.20–0.86)	0.22 (NA–NA) **

Incidence rate ratios (IRRs) were estimated using zero-inflated negative binomial regression models. These models can account for overdispersion and the large number of zero CJS contacts. They included a negative binomial component for the count outcome and a logistic component, with only an intercept, to handle excess zeros. Follow-up time was included as an offset using the log of person-years. Crude models included only ASD status, while adjusted models also controlled for socioeconomic status (SEFI), maternal immigration status, mood and anxiety disorders, and intellectual disability. Matched controls were used as the reference group. These models used the discordant ASD definition. *Not Significant ** Model was not able to compute the confidence interval due to limited number of events and observations.

A.4.4 Discordant group Diagnostic assessment

No violations of the proportional hazard assumption were found in the models fitted for the discordant group using Schoenfeld test and residual plots.

When violations of the proportional hazard assumption were identified, time-varying model specifications were tested. Adding time-dependent effects did not meaningfully change the direction or interpretation of the results. For this reason, results from the standard Cox proportional hazards models are presented in the tables. Detailed diagnostic results for the sensitivity analyses are therefore not shown separately.