Attention-Deficit/Hyperactivity Disorder in Manitoba Young Adults:

A Population-Based Study

by

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Abstract

Background: The understanding that Attention Deficit/ Hyperactivity Disorder (ADHD) commonly persists into adulthood has not been widely accepted until recent years. Accordingly, much less is known about diagnostic and treatment prevalence, or the health and social outcomes of ADHD in adulthood compared to childhood.

Objectives: 1.) Determine the lifetime prevalence of ADHD diagnosis and psychostimulant prescriptions for Manitoba young adults and explore how diagnostic prevalence differs according to sex, region of residence, age, age at diagnosis, and socioeconomic status (SES). 2.) Investigate whether a socioeconomic gradient exists within the population of Manitoba young adults with a lifetime diagnosis of ADHD, as well as whether variables such as region of residence, age, or age at diagnosis moderate this relationship. 3.) Investigate whether a relationship exists between ADHD in Manitoba young adults and health service utilization for several mental health, physical health, and social outcomes.

Methods: Using the Manitoba Population Health Research Data Repository, this cross-sectional analysis used 24 fiscal years of data (1984/85 to 2008/09) and included all adults aged 18 to 29 during 2007/08 to 2008/09 in the province of Manitoba (n= 207,544) who had a lifetime diagnosis of ADHD. First, crude prevalence was calculated for lifetime ADHD diagnosis (7.11%) and psychostimulant prescriptions (3.09%), in addition to diagnostic rates according to sex, age, age at diagnosis, region of residence and socioeconomic status (SES). Next, the presence of a socioeconomic gradient in lifetime ADHD diagnosis was investigated using Poisson and negative binomial regression analyses. Finally, relationships between young adults with lifetime ADHD diagnosis and health service utilization for several health and social outcome variables were explored using a matched cohort design with general population and chronic condition comparison groups. These analyses employed Generalized Estimating Equation regression models with a Poisson distribution.

Results: In relation to previous Manitoba research on childhood ADHD, the socioeconomic gradient for ADHD diagnosis was found to dissipate into young adulthood. However, when region of residence was accounted for, a small inverse gradient in the urban population and a direct gradient in the rural population were evident. Also, individuals from the very highest income quintile were significantly less likely to be diagnosed before age 18 compared to all other income quintiles. In the matched cohort analyses, the outcome variables that were significantly correlated with lifetime ADHD diagnosis included: depression, anxiety, personality disorders, conduct disorder, substance abuse, multiple types of injuries, receipt of income assistance, and reduced high school graduation.

Conclusions: Given the high lifetime prevalence (7.11%) of ADHD in Manitoba young adults, the significant socioeconomic correlates for diagnosis, and multitude of significant adverse health and social outcomes in this population, further investigation into the trajectory of this relatively unexplored population is recommended, particularly in relation to secondary outcomes. Furthermore, continued measurement of the provision and success of additional support resources in this population will ultimately be necessary for the development of policies and practices that will enhance the health status of all Canadian adults living with ADHD.

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Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is often cited as one of the most commonly diagnosed mental health disorders in children. In the *Diagnostic and Statistical Manual of Mental Disorders, Tenth Edition, Text Revision* (DSM-IV-TR), ADHD is defined as persistent and developmentally inappropriate problems with inattention and/or impulsivity and hyperactivity that commence prior to the age of seven (American Psychiatric Association, 2000). Consequently, ADHD is typically diagnosed in elementary school years, although it is currently understood as a chronic condition that often persists into adulthood (American Psychiatric Association, 2000). Furthermore, experts now suggest that the age of onset criterion (AOC; i.e. “prior to the age of seven”) should be removed from the next edition of the DSM and replaced with an AOC of “in childhood or adolescence” because there is no evidence of significant differences between individuals who otherwise meet all criteria for ADHD except for the AOC and those who do show symptoms prior to age seven (Barkley, Murphy, & Fischer, 2008; Barkley, 2010).

Additionally, there is evidence to suggest that symptom representation often changes across the lifespan, with hyperactivity being a much less common feature of adult ADHD compared to child ADHD (Barkley, Murphy, & Fischer, 2008). In their research, the 6 symptoms that best distinguished adults with ADHD from clinical control cases were: “(1) makes decisions impulsively, (2) has difficulties stopping activities or behavior when should do so, (3) starts projects or tasks without reading or listening to directions carefully, (4) poor follow through on promises, (5) trouble doing things in their proper order, and (6) drives with excessive speed" (Barkley, Murphy, & Fischer, 2008). While work towards adult ADHD diagnostic criteria remains in progress for the next edition of the DSM, it appears that there is strong evidence to support the idea that the current DSM-IV-TR criteria are insufficient for adequately identifying adult ADHD.

Accordingly, much less is known about diagnostic and treatment prevalence rates of ADHD in adults than in children. One American study estimated a prevalence of 4.4% with a nationally representative sample of adults 18 to 44 years of age (Kessler et al., 2006). Another survey of employed citizens from ten countries done by the World Health Organization (WHO) found an overall adult ADHD prevalence rate of 3.5% (de Graaf et al., 2008). Given the challenge of somewhat ambiguous diagnostic criteria for adult ADHD, it seems likely that these figures may underreport true prevalence rates.

The Socioeconomic Gradient

Past research in the Manitoba child population has found a socioeconomic gradient in ADHD diagnoses and treatment in urban areas, with children from the lowest income areas having the highest rates (Brownell & Yogendran, 2001; 2005; Yallop, 2008). Such research has yet to be done with an adult population. Research focusing on other health outcomes has generally found not only that lower socioeconomic status (SES) is associated with poorer health, but that the relationship between SES and health forms a gradient, with increases in health with each increase in SES (Adler et al., 1994; Marmot et al., 1991).

Understanding whether such a gradient exists for young adults with ADHD could have important treatment implications. For example, if young adults from lower SES backgrounds are more likely to receive ADHD diagnoses at some point during their lives, and previous research has found that diagnosis is associated with multiple secondary symptoms that impact health, quality of life, and productivity (Antshel & Barkley, 2009; Bernfort, Nordfelt, & Persson, 2008; Wehmeier, Schacht, & Barkley, 2010), then one would anticipate very poor health and social outcomes in this subpopulation. Such findings would strengthen the argument for enhancing education and health programs in lower SES regions in order to promote environments that improve the management of this disorder. This in turn could lead to better outcomes for those diagnosed with ADHD.

Region of residence is also an important variable in ADHD research. Rowland, Lesesne, & Abramowitz (2002) indicate that prevalence rates for ADHD are higher in children in urban areas compared to children in rural areas. Brownell & Yogendran's Manitoba research (2001; 2005) also found that children in urban areas were more likely to be diagnosed with ADHD than children from rural areas, although ADHD-diagnosed children from rural locations were more likely to receive medications, particularly if they were from higher income levels. This finding supports further investigation into the relationship between region of residence and SES for diagnosis and treatment rates of ADHD. However, the authors suggested that this finding may be in part caused by the lack of data on health care received in nursing stations in certain northern remote rural locations (Brownell & Yogendran, 2001; 2005; Yallop, 2008).

Furthermore, age at diagnosis is another important variable for consideration in regard to researching ADHD and SES. For example, research suggests that an earlier estimated age of onset of ADHD symptoms in children is associated with a greater degree of comorbid aggressive, delinquent, and anxious/depressive symptoms in children and adults with ADHD (Barkley, Murphy, & Fischer, 2008; Connor et al., 2003). In addition, research also indicates that those diagnosed with ADHD in adulthood have less comorbid antisocial personality disorder and substance abuse disorders and are less functionally impaired than those diagnosed in childhood (Barkley, Murphy, & Fischer, 2008). Consequently, it is possible that age at diagnosis may have a moderating effect on the socioeconomic gradient.

A great deal of the research on ADHD focuses on treatment using psychostimulant medications (Harpin, 2005; Steer, 2005). However, there is growing concern about how frequently such medications are prescribed (Vitiello, 2001). Some of this concern comes out of findings that certain population groups, such as those with lower SES, tend to receive higher rates of such prescriptions (Brownell & Yogendran, 2005; Miller, Lalonde, McGrail, & Armstrong, 2001). Another concern that was published in a review on adult ADHD involves the greater risk for adverse cardiovascular events associated with long-term psychostimulant use (Okie, 2006). While research supports multimodal treatment of ADHD, including psychosocial therapies (Dodson, 2005; The MTA Cooperative Group, 1999), the presence of a socioeconomic gradient that persists into young adulthood would provide additional support for increasing non-pharmaceutical treatments for ADHD in low-income areas.

Common Comorbidities:

Reviews on outcome studies state that in addition to the primary ADHD impairments in nonverbal and verbal working memory, mental computation, and application of organizational strategies, several secondary conditions commonly continue into adulthood for at least 50-70% of individuals with ADHD (Bernfort, Nordfelt, & Persson, 2008). These secondary conditions include depression, anxiety, impaired social relationships, low self concept, drug use, antisocial behavior, injuries and occupational disadvantages (Barkley & Brown, 2008; Bernfort, Nordfelt, & Persson, 2008; Ingram, Hechtman, & Morgenstern, 1999). Similarly, a review article on adults with ADHD indicated that 65 to 89% of ADHD patients are diagnosed with one or more additional psychiatric conditions (Sobanski, 2006). With most of this research coming from the United States and Europe, it is of great importance to gain an understanding of both the prevalence and correlates of adult ADHD in the Canadian population.

Major depressive disorder (MDD) has been identified as one of the most common comorbid conditions in adult ADHD (Antshel & Barkley, 2009; Fischer et al., 2007). Clinical research reports prevalence of 16% to 31% for comorbid MDD in adults with ADHD (Alpert et al., 1996; Barkley, Murphy, & Fischer, 2008; Biederman et al., 1993). Kessler et al.'s (2006) nationally representative survey study reported that within their sample of adults with ADHD, 18.6% had MDD, 19.4% had bipolar disorder, 12.8% had dysthymia (a chronic, low-grade depressive disorder), and 38.3% had any type of mood disorder. While bipolar disorder is reported as highly comorbid in this study, its relationship to ADHD is considered more controversial due to symptom overlap and debate around etiology of the two disorders (Antshel & Barkley, 2009).

Anxiety disorders are also commonly comorbid with adult ADHD. Reported prevalence of comorbid anxiety in adults diagnosed with ADHD ranged from 13.7% to 47.1% (Kessler et al., 2006; Secnik, Swensen, & Lage, 2005). More specifically, in adults with ADHD the following anxiety disorders are very commonly comorbid: social phobia (29.3%), specific phobia (22.7%), post traumatic stress disorder (11.9%), panic disorder (8.9%), generalized anxiety disorder (8.0%), and agoraphobia (4.0%; Kessler et al., 2006). Odds ratios indicated that all of these disorders were significantly more common in adults with ADHD compared with those without ADHD (Kessler et al., 2006).

Also highly comorbid with ADHD are conduct disorder (CD) and oppositional defiant disorder (ODD), which are behavioral disorders that are typically diagnosed in childhood. In clinical samples of adults with ADHD, 24% to 32% also had CD and/or ODD (Biederman et al., 1993; Biederman et al., 1996). Another study that looked at comorbidity outcomes in a clinical sample of adults with persistent ADHD found that 31.1% of their sample had been diagnosed during childhood with CD and 41.1% had been diagnosed with ODD (Downey, Stelson, Pomerleau, & Giordani, 1997).

Childhood diagnoses of CD and ODD are often precursors for antisocial personality disorder (APD), such that having persistent defiant and disruptive behavioral concerns in childhood frequently leads to an antisocial personality style in adulthood (Burke, Loeber, & Birmaher, 2004). The current literature indicates that 13% of adults with ADHD from a clinical population also have APD (Downey, Stelson, Pomerleau, & Giordani, 1997), although the lifetime prevalence of APD in adults with ADHD is 44% (Torgersen, Gjervan, Rasmussen, 2006). While little research has been conducted on ADHD and other personality disorders, there have been significant findings for the increased prevalence of comorbid obsessive–compulsive personality disorder, passive–aggressive personality disorder, depressive personality disorder, narcissistic personality disorder, and borderline personality disorder in adults with ADHD (Cumyn, French, & Hechtman, 2009; Fossati, Novella, Donati, Donini & Maffei, 2002). In general, personality disorders refer to patterns of experience and behavior that are pervasive and inflexible, markedly different from cultural expectations, have an adolescent or adult onset, and lead to impairment or ongoing distress (American Psychiatric Association, 2000).

Substance abuse disorders also commonly co-occur with adult ADHD, although there have been some mixed findings. For example, clinical studies without control groups have found that one third of adults with ADHD have an alcohol use disorder and one fifth to one third have some other type of substance use disorder; typically with cannabis or cocaine (Downey, Stelson, Pomerleau, & Giordani, 1997; Shekim, Asarnow, Hess, Zaucha, & Wheeler, 1990; Torgersen, Gjervan, & Rasmussen, 2006). However, a more recent nationally representative survey study found that only drug abuse and dependence disorders and not alcohol abuse and dependence disorders were significantly comorbid with adult ADHD (Kessler et al., 2006), suggesting that only non-alcoholic substance abuse is associated with adult ADHD. Still, there does appear to be an important link between ADHD and substance abuse, as several clinical studies of adults with various types of substance abuse have found comorbid ADHD prevalence rates of 15% to 24% (Clure et al., 1999; Levin, Evans, & Kleber, 1998; Schubiner et al., 2000). Furthermore, there is some emerging research suggesting that additional comorbidities, such as conduct disorder and APD are significantly comorbid with substance abuse disorders in adults with ADHD (Barkley, Fischer, Smallish, & Fletcher, 2003; Biederman, 2003). Consequently, more investigation into adult ADHD and comorbid substance abuse disorders, along with possible correlates, is critical to further elucidate these relationships.

Injuries are also more common in adults diagnosed with ADHD. In particular, research has demonstrated a highly significant relationship between adult ADHD and increased frequency of motor vehicle incidents, especially speeding violations, and at-fault collisions (Barkley, Murphy, & Kwasnik, 1996; Barkley, Murphy, & Fischer, 2008; Fried et al., 2006). Furthermore, another study that looked more broadly at injuries found that adults with ADHD were moderately prone to low trauma injuries (i.e. sports-related injuries and simple falls) and highly prone to high trauma injuries (i.e. falls from heights of at least five meters and motor vehicle collisions (Kaya et al., 2008). In regard to violence against self, preliminary studies suggest that there is a significant link between suicidal behavior and ADHD in adolescents and adults, particularly those with other comorbid conditions such as depression and conduct disorder (James, Lai, & Dahl, 2004; Manor et al., 2010).

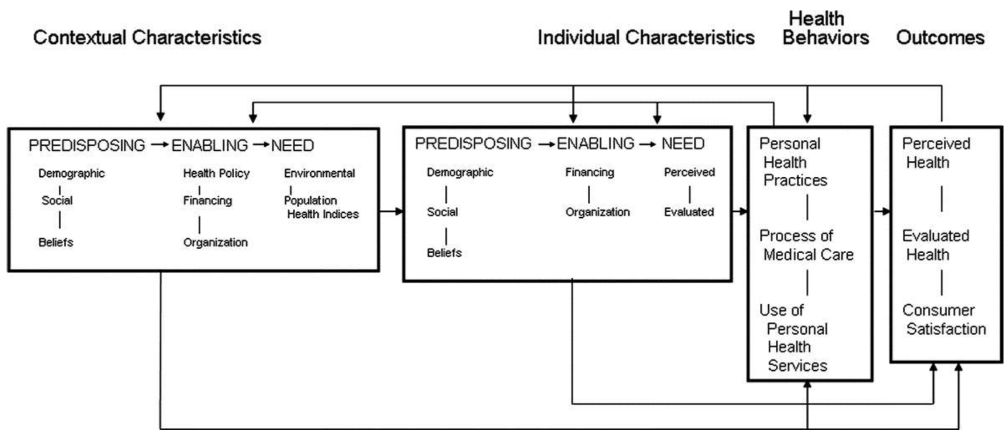
Educational outcomes and occupational disadvantages in adults with ADHD are another area of concern. One study that compared 158 clinically diagnosed young adults with ADHD to a community control sample found that those with ADHD completed significantly fewer years of education, with almost 1 out of 3 failing to graduate from high school (Barkley, Fischer, Smallish, & Fletcher, 2006). Results from this same study found higher rates of being fired from jobs, along with corresponding increases in unemployment in young adults with ADHD compared to the control group (Barkley et al., 2006).

Altogether, the emerging evidence of multiple secondary symptoms that persist into adulthood undoubtedly corresponds with increased health service utilization in this population. In their review, Bernfort, Nordfelt, & Persson (2008) noted that young adults with ADHD had higher healthcare costs and productivity loss compared with the normal population. Despite some evidence of life-long outcomes of living with ADHD, relatively little research has been conducted with adult ADHD populations.

Behavioral Model of Health Services Use

The conceptual framework of this dissertation employs Andersen's Behavioral Model of Health Services Use (1973, 1995, and 2008), a frequently used model in health services utilization research (Bergeron, Poirier, Fournier, Roberge, & Barrette, 2005; Fleury, Grenier, Bamvita, Perreault, Kestens, & Caron, 2012), as it incorporates multiple levels of individual-level and community-level factors in the consideration of health behaviors and outcomes. As can be observed in Figure 1, this model outlines four major components in health service utilization: contextual characteristics (e.g., community-level characteristics, health policies, and environmental factors), individual characteristics (e.g., demographic characteristics, individual-specific social factors, financial circumstances, and an evaluation of need based on external and internal factors), health behaviors (e.g., health practices and medical care environment), and outcomes (e.g., internal and external perceptions/measures of health outcomes and satisfaction with the services received).

Figure 1. Behavioral model of health services use (Andersen, 2008)



Furthermore, contextual and individual characteristics can be categorized according to: predisposing features (i.e., those present prior to health care contact), enabling factors (i.e., factors impacting one's means to access health services), and need factors (i.e., perceived and evaluated health status). Not only does this model recognize the importance of individual and contextual factors in health behaviors and outcomes, it also incorporates the ongoing mutual relationships that each of these factors have on each other. For example, the experiences of health care system employees regarding consumer health behaviors and subsequent health outcomes can subsequently impact future health policies or evaluation practices.

The current study incorporates several components of Andersen's model (2008). In regard to contextual characteristics, the universal availability of health care services in Canada allows for the inclusion of virtually all health contacts (i.e., physician visits, hospitalizations, and pharmaceutical administration) in the province, according to the study parameters. Multiple individual characteristics are also considered, including demographic information such as sex and age, as well as social factors, such as region of residence, SES, receipt of income assistance, and education (i.e., high school graduation). Perception of need at the individual level is likely an underlying factor in ADHD diagnosis and treatment, as the behavioral symptoms significantly impact one's ability to function by definition of the diagnosis (American Psychiatric Association, 2000). Since data on some health service usage (e.g., diagnosis and/or treatment from public or private sector psychologists) was not available for the present study, we do not capture individual use of such health services. However, health behaviors and outcomes are generally well-represented in this study through diagnosis and psychostimulant treatment of ADHD, and diagnosis of multiple mental and physical health variables. Given that the present study involves the investigation of a socioeconomic gradient in lifetime ADHD diagnoses and an analysis of several mental and physical health outcome variables, as well as educational and occupational outcomes, the behavioral health model of health service utilization is an appropriately comprehensive and fitting framework.

Study Rationale

This study investigated diagnosis and treatment prevalence of ADHD in young Manitoba adults, as well as diagnosis prevalence according to several demographic variables. Subsequently, this analysis adds to the literature on ADHD with relation to diagnosis, psychostimulant prescriptions, SES, sex, age, age at diagnosis, and region of residence. Additionally, it furthers Manitoba research in this area by considering whether the SES gradient in urban areas for individuals diagnosed or treated with ADHD persists into young adulthood, whether variables such as region of residence, age, and age at diagnosis are moderators of the gradient, and whether more resources need to be specifically allocated to young adults with ADHD living in low-income areas. Finally, this study provides an exploration of whether health and social service utilization in young adults who have had an ADHD diagnosis is higher than both general population and chronic illness comparison groups. This analysis is an important first step in understanding whether young adults who have had an ADHD diagnosis are more at risk for secondary symptoms.

Objectives

The main research objectives of this study were:

1) To determine the lifetime prevalence of ADHD diagnosis and psychostimulant prescriptions for Manitoba young adults (ages 18 to 29) using data from 1984 to 2009 for the young adult population. Furthermore, to explore how diagnostic prevalence differs according to sex, region of residence (rural and urban), age, age at diagnosis, and SES.

2) To investigate whether a socioeconomic gradient exists within the population of Manitoba young adults who have had a diagnosis at some point during their lives, as well as whether variables such as region of residence, age, or age at diagnosis moderate this relationship.

3) To investigate whether a relationship exists between ADHD in Manitoba young adults and health service utilization for depression, anxiety, conduct disorder, personality disorders, substance abuse, increased rates of injuries, difficulties maintaining employment, and poor educational outcomes.

Corresponding Research Questions and Hypotheses

Research Question 1:

What is the overall crude prevalence of ADHD diagnosis in Manitoba young adults, as well as crude prevalence according to sex, region of residence, age and age at diagnosis, and socioeconomic status? Additionally, what is the crude prevalence of ADHD psychostimulant treatment in Manitoba young adults?

Hypotheses:

As this descriptive analysis was exploratory, in that it was conducted with a population that had not previously been investigated, hypotheses were based on the small literature available with relevant samples. The following were the hypotheses for each of the crude prevalence rates calculated:

1. While there is relatively little research on the prevalence of adult ADHD, one study using the National Comorbidity Survey Replication estimated the prevalence of adults aged 18 to 44 in the United States to be 4.4% (Kessler et al., 2006). Since previous ADHD research on the Manitoba child population (Yallop, 2008) found rates that are about 41.3% lower than those in the United States (Bloom & Cohen, 2007), it was hypothesized that adult ADHD prevalence in Manitoba adults would be approximately 1.82%.
2. Based on previous findings (Kessler et al., 2006), it was hypothesized that more men than women would be diagnosed with ADHD, with an approximate ratio of 2:1.

3. It was hypothesized that there would be higher prevalence of diagnosis of ADHD for young adults in urban areas compared to those in rural locations. This hypothesis was based on findings from Kessler et al. (2006) with adult data as well as Rowland, Lesesne, & Abramowitz (2002) and the Manitoba studies by Brownell et al. (2012), Brownell & Yognedran (2001; 2005), Martens et al. (2004), and Yallop (2008) using data with child populations.
4. As research does not support the existence of any significant age trends in adult ADHD (Kessler et al., 2006), it was anticipated that there would be no significant differences across age. Age was investigated to get a sense of the demographics of the study sample.
5. While there was little information on age at diagnosis during the adult years, the anticipated age at diagnosis during childhood was expected to follow the patterns from past Manitoba research on ADHD in childhood. Specifically, it was hypothesized that ADHD diagnosis prevalence would be highest at ages 10 to 13 years, next highest at 7 to 9 years, then 14 to 29, 4 to 6, and 0 to 3 years (Brownell & Yogendran, 2001; 2005; Martens et al., 2004, Yallop, 2008).
6. In terms of SES, adults with lower SES were expected to have higher prevalence of diagnosis compared to those with higher SES and this relationship was predicted to occur in an inverse gradient form (i.e. increasing prevalence of ADHD with decreasing SES). As no previous research had investigated adult ADHD according to income quintiles, this hypothesis was supported by the findings from child ADHD studies of Miller et al. (2001), Brownell and Yogendran (2001, 2005) and Yallop (2008).

7. The majority of this study focused on diagnostic prevalence and correlates of ADHD in young adults. However, crude prevalence of psychostimulant treatment was calculated (i.e., using a data capture period of two fiscal years: 2007/08 to 2008/09) to provide information about how many young adults were receiving psychostimulant treatment during this study period. Little epidemiological research on psychostimulant use had been conducted with adult populations, although Kessler et al. (2006) found that .48% of adults 18 to 44 were currently receiving treatment for ADHD. Consequently, it was hypothesized that the values in the present study would be somewhere in the range of .20% to .48%, given that Manitoba prevalence is typically lower than that in the United States.

Research Question 2:

Is there a socioeconomic gradient in the diagnosis and treatment of ADHD in Manitoba young adults? Furthermore, does this relationship vary according to region of residence (i.e., urban versus rural), age (i.e., within six 2-year age groups of the 18- to 29-year-old study population), or age at diagnosis (i.e., under 18 versus 18 and older)?

Hypotheses:

It was hypothesized that there would be an inverse socioeconomic gradient for overall and urban diagnostic prevalence of ADHD in young adults based on prior Manitoba population-based research with the child population (Brownell & Yogendran, 2001; Martens et al., 2004;Yallop, 2008). It was also hypothesized that for adults living in rural areas, higher diagnosis prevalence would be found in adults with higher SES. This hypothesis was based on results from Brownell & Yogendran (2001; 2005) and

Yallop (2008). In regard to the SES by age interaction, it was hypothesized that the socioeconomic gradient would steepen with increasing age. This is based on past research that linked ADHD with poor educational and occupational outcomes (Bernfort, Nordfelt, & Persson, 2008), which would likely also correspond to a reduction in SES over the course of young adulthood (i.e., the period when youth typically enter the workforce). Finally, it was hypothesized that for individuals diagnosed and treated in childhood, higher diagnostic prevalence of ADHD would be found in adults from lower income areas, whereas no socioeconomic gradient pattern would be found in ADHD diagnostic prevalence for those diagnosed in adulthood. While there was no literature regarding the socioeconomic gradient and child versus adult age at diagnosis, this hypothesis was based on the findings from Mannuzza, Klein, Bessler, Malloy, & Hynes (1997), who found that adults who had primary ADHD symptoms in childhood were more likely to have lower-status employment.

Research Question 3:

Do young adults with ADHD diagnoses have increased health and social service utilization compared to two comparison groups (a general population group and an asthma group)?

Hypotheses:

It was hypothesized that the ADHD group would have higher rates of health and social service utilization compared to either comparison group, as outcome studies had found that a majority of individuals with ADHD continue to experience health and social deficits into adulthood (Ingram et al. 1999; Harpin, 2005; Bernfort, Nordfelt, & Persson, 2008). The symptoms that were noted as commonly continuing into adulthood included depression, anxiety, conduct disorder, personality disorders, substance abuse, increased rates of injuries, difficulties maintaining employment, and poor educational outcomes (Ingram et al., 1999; Harpin, 2005; Secnik, Swensen, & Lage, 2005; Kessler et al., 2006; Barkley & Brown, 2008; Antshel & Barkley, 2009).

Methods

Data Sources

Using the Manitoba Population Health Research Data Repository (a wide-ranging collection of databases that includes records for virtually all contacts with provincial health care services), this cross-sectional analysis used 24 fiscal years of data (1984/1985 to 2008/09) and included all adults aged 18 to 29 in the province of Manitoba during 2007/2008 to 2008/2009 (n= 207,544) with a lifetime diagnosis of ADHD. Manitoba Health, the government department which administers the health insurance program for the province, provided these data for use at the Manitoba Centre for Health Policy (MCHP). The data were transferred in the form of anonymized records of Manitoban residents' interactions with the health care system. Due to the fact that Manitoba has a health care system that offers universal coverage, health services reported in this database include the large majority of services received by virtually all Manitobans who have made contacts with the health care system.

Most health data for Manitobans are available in the Repository from 1984 onward. All records in the Repository are anonymous, as they contain no names or addresses. Instead, an encrypted identifier, the Personal Health Identification Number (PHIN), allows for linkages across databases and years of data. The health data in the Repository have been studied extensively and validated for research purposes (Roos et al., 1993; Roos & Nicol, 1999).

Physician claims files were used to determine diagnosis prevalence of ADHD in Manitoba young adults. The data originated from the Manitoba Health Services Insurance Plan (MHSIP) records, which is the agency that facilitates health care coverage for Manitoba residents. Most physicians in Manitoba are reimbursed for their services on a fee-for-service basis. Consequently, almost all physician visits are captured in this database, with the exception of emergency visits and services from certain salaried and sessional physicians for whom there were no evaluation claims. Visits to nurses at nursing stations, which occur mostly in northern remote communities, are also not always captured in the Repository, particularly in years prior to 2006, which may have led to undercounting of ADHD diagnosis and psychostimulant treatment for young adults residing in these communities. Each claim contains a unique numerical family identifier and a numeric patient identifier. Additionally, all claims include an *International Classification of Diseases, Ninth Edition, Clinical Modification* (ICD-9-CM; Hart, Schmidt, & Aaron, 1999) or *International Classification of Diseases, Tenth Edition, with Canadian Enhancements* (ICD-10-CA; World Health Organization, 2006) diagnosis code (recorded to the third digit).

Hospital files were used in the same manner, as some diagnoses and treatment for ADHD may have occurred in hospital. These files contained abstracts (summaries) of demographic (including PHIN) and clinical information for all hospital discharges as part of the global operating budget funding process. The information contained in the hospital discharge databases is generally considered very accurate, as abstracts missing information are returned to the hospital by the Canadian Institute for Health Information for completion.

Psychostimulant and asthma medication prescription information was taken from the Drug Program Information Network (DPIN), which contains administrative data with records of prescriptions given to Manitoba residents for use out of hospital. In other words, all prescriptions filled in pharmacies or hospitals (for outpatients) are recorded in the DPIN. These claims are coded using numeric patient identifiers, drug identification numbers (DIN) or Anatomical Therapeutic Chemical (ATC) Drug Classification System numbers, and information on quantity and date given.

Data on income assistance came from Manitoba Entrepreneurship, Training, and Trade, and included information on receipt and duration of assistance at the family-level. Data on education came from Manitoba Education and included individual-level information on course completion and graduation.

Study population, study period, and definitions

For this study, prevalence of diagnosis was determined from physician visits and hospitalizations, using the ICD-9-CM (for hospital abstracts prior to 2004/05 and physician files) and ICD-10-CA (for hospital abstracts as of April 1, 2004) classification systems. ADHD was represented by the ICD-9-CM code of 314 (termed hyperkinetic syndrome of childhood) and the ICD-10-CA code of F90 (termed hyperkinetic disorders). In addition, individuals who had two or more prescriptions for a psychostimulant and no diagnosis for Conduct disorder, Narcolepsy or Catalepsy (which are also sometimes treated with psychostimulants) were classified as having a diagnosis of ADHD. A comprehensive list of diagnostic codes and definitions for ADHD, asthma, and all other secondary conditions included in the study can be found in Appendix A. Furthermore, comprehensive lists of the associated medication codes that were included in the definitions for ADHD (i.e. psychostimulants) and asthma (i.e. asthma medications), can be found in Appendix B.

Treatment prevalence for the crude prevalence analysis was based on the two or more prescriptions for a psychostimulant (including Ritalin, Dupram, Vivarin, or Dexedrine) occurring during the study period (see Appendix B). Physician claims, hospital discharge, and Drug Program Information Network (DPIN) files informed diagnosis prevalence, and treatment was defined by prescriptions made in Manitoba health drug claims records (from DPIN). These methods of determining ADHD and treatment prevalence were defined for use with Repository data by Brownell and Yogendran (2001; 2005), Martens et al. (2004), and Yallop (2008).

While other forms of treatment for ADHD, such as behavior therapy, are also employed by some Manitoba health practitioners (e.g. psychologists), this study only considered treatment with respect to psychostimulant use. This decision was based on the lack of comprehensiveness of information on other treatment types as well as the pervasiveness of psychotropic treatment for ADHD.

Prevalence of diagnosis for ADHD was analyzed according to the following categories: sex, urban and rural provincial regions of residence (to be determined by municipal and postal codes, with *urban* referring to residents of Winnipeg and Brandon and *rural* referring to all other residents of Manitoba), age (calculated from date of birth listed in the registry), age at diagnosis (calculated as the first time during the lifespan that a diagnosis of ADHD is made in the health care system, according to the study definition), and SES (based on income). To measure SES, this study used an area-level average household income (grouped into quintiles) derived from Census data. The Census data were aggregated according to the dissemination area (i.e., the smallest geographic unit for which all Census data are disseminated), ranked according from poorest to wealthiest, and then grouped into five income quintiles with approximately twenty percent of the population in each quintile. The reasoning for using this construct for SES is that past research on ADHD in Manitoban children has used income quintiles as the variable for SES (Brownell & Yogendran, 2001; Martens et al., 2004, Yallop, 2008), which allows for more interpretable comparisons. Furthermore, some researchers suggest that asset-based measures of SES, such as income, may be more sensitive to detecting gradients over time because they are more prone to fluctuate (Chen, Martin, & Matthews, 2006). The variable of ethnicity was considered for inclusion, but left out because past research suggests that rates of ADHD do not differ significantly across various ethnic groups (Dwivedi & Banhatti, 2005). All of these variables were captured using two fiscal years of data (2007/08 to 2008/09).

Finally, secondary symptoms were based on 5 fiscal years (2004/05 to 2008/09) of medical claims data (i.e. depression, anxiety, personality disorders, conduct disorder, substance abuse, and multiple injury categories), social assistance data (i.e. occupational disadvantage), and education data (i.e. meeting the course requirements for graduation). As previously mentioned, all diagnostic codes, drug codes, and their associated definitions for the secondary condition analysis can be found in Appendices A and B. Most of the definitions used in this analysis have been previously validated for use with this dataset (Doupe et al., 2008, Fransoo et al., 2009; Martens et al., 2004). Social assistance is defined as a binary yes/no variable based on receipt of income assistance. Educational attainment was determined by high school completion status, defined by having "graduation" as the year-end status, or the presence of all required course credits, within a six-year period of beginning grade nine, in the Education files.

The injury categories included: hospitalization for any injury, injury from being the driver of any vehicle, injury from involvement in a motor vehicle traffic collision, injury from a non-traffic, any vehicle collision, injury from falls, injury from poisoning, injury from intentional self harm, injury from assault, injury from exposure to inanimate mechanical force (i.e., struck by thrown, projected, falling or stationary object, caught, crushed, jammed, or pinched in or between objects, contact with lifting and transmission devices, contact with sharp glass, contact with knife, sword, or dagger, contact with tools and machinery, firearm discharge, explosion, foreign object entering the body, hypodermic needle contact, or unspecified inanimate mechanical forces), injury from overexertion, travel and privation (i.e., overexertion and strenuous or repetitive movements, travel and motion, prolonged stay in weightless environment, lack of food or water, or unspecified privation), and other types of remaining injuries (i.e., exposure to smoke, fire, and flames, contact with heat and hot substances including burns, contact with venomous animals and plants, exposure to forces of nature, unintentional drowning, unintentional strangulation, sports injury, sequelae/ late effects of previous injuries, exposure to animate mechanical forces including animal bites and injuries, exposure to electric current, and legal intervention and operations of war). This category was created to represent remaining injuries, but grouping them due to relatively rare nature of these events. Please see Appendix A for the specific ICD-10-CA injury codes used.

Data Analysis

The cross-sectional and correlational study design utilized both crude prevalence and regression analyses. Crude prevalence was calculated by dividing the number of individuals with diagnoses or prescriptions by the total population relevant for the measure. Single outcome Poisson regression analyses were conducted to test if there were significant differences in crude prevalence rates.

The socioeconomic gradient analysis used Poisson regression analyses, which models counts of the number of events in a population stratum as a function of explanatory variables. Variables with theoretical support in the literature were included in the regression models (i.e., sex, age, urban vs. rural region of residence, and income quintile). Negative binomial distribution was used in instances when overdispersion was observed in the models. Two-way interactions among explanatory variables such as SES* region of residence, SES* age, and SES* age at diagnosis were also investigated.

The relationship between ADHD diagnosis and service utilization was explored with a matched cohort design (using a chronic condition comparison group and a regular population comparison group). Asthma was selected as the chronic condition comparison group because it is a common health condition that generally results in increased health care utilization, it is well represented in the data and the definition used in this study was previously validated by Kozyrskyj et al. (2004) and Lix et al. (2006). Comparisons were made on patterns of utilization of health and social services. Both the asthma and general population comparison groups included young adults living in Manitoba in 2007/08 through 2008/09 and matched to the ADHD group on sex, six level age group (i.e., 18 to 19, 20 to 21, 22 to 23, 24 to 25, 26 to 27, and 28 to 29 years), and three-digit postal code. Young adults with an asthma diagnosis at any point from five years of age onward, who had never received an ADHD diagnosis, were considered for the asthma comparison group. Young adults in the general population group had no ADHD diagnoses at any point. The asthma diagnosis and drug codes, as well as the definition can be found in Appendices A and B. Up to four-to-one matching was used in all models, and matching rates between cases and controls are presented for each set of analyses. Case and comparison groups were matched on sex, age group, and three-digit postal code.

The service utilization analysis used a Poisson Generalized Estimating Equation (GEE) regression analysis to test for differences in the relative rates across case and comparison groups, after controlling for confounding covariates (i.e., sex, age group and income quintile). Analyses were conducted on datasets summarized according to matched cohort clusters. Models included a log link function and an offset term of the natural logarithm of each cluster, as this corresponds with modeling the dependent variable as a rate. The repeated measure statement was sex* age group* three-digit postal code, as this corresponds with the matched clusters. Also, an exchangeable correlation structure was employed, which assumes non-zero, uniform correlations for all pairs of within-subject variables. A Poisson distribution assumes that the mean and the variance are equal and is ideal for modeling rate and count data, for which a non-normal error distribution would be expected. The exponentiated coefficients can be interpreted as relative rates (RRs) or percentage increases or decreases associated with the covariate. An RR of 1 represents no association between groups, an RR above 1 indicates a significantly higher rate of the outcome variable in the study group, and an RR below 1 indicates a significantly lower rate of the outcome variable in the study group. Also, 95% confidence intervals (CIs) for RRs that include 1 indicate lack of statistical significance at $p < .05$. All data analyses were performed using SAS® statistical analysis software, Version 9.3 (2011).

Results

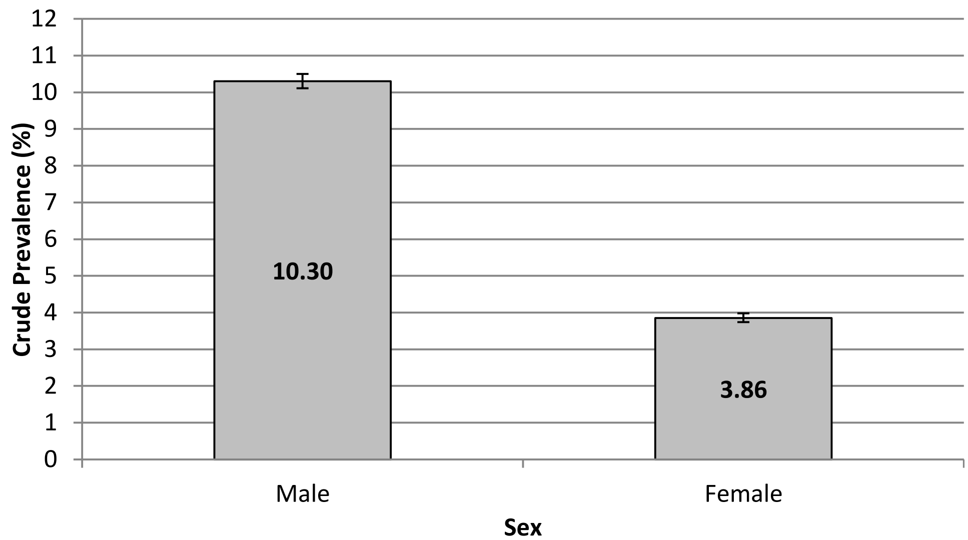
Crude Prevalence Analysis

The overall crude prevalence of lifetime ADHD diagnosis for Manitoba young adults (aged 18 to 29) in the 2008/09 fiscal year was 7.11%, with 14,762 young adults having an ADHD diagnosis as defined in this project out of a total provincial young adult population of 207,544. For a complete listing of all crude prevalence results in a table format, see Appendix C.

Sex

The results for crude prevalence according to sex give the expected ratio of 2 or 3 to 1 for lifetime diagnosis. Out of the total male young adult population of 104,856, 10,803 (10.30%) had a lifetime diagnosis for ADHD and 3,959 out of 102,688 (3.86%) young adult females had a lifetime diagnosis of ADHD (see Figure 2).

Figure 2. Crude prevalence of lifetime ADHD diagnosis by sex in Manitoba young adults in 2008/09

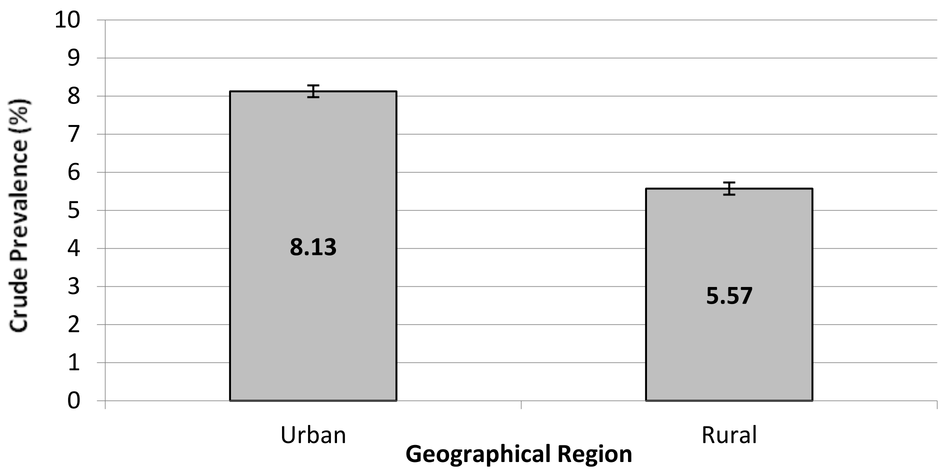


Region of Residence

In terms of region of residence within Manitoba, the general pattern of higher crude prevalence in urban areas as compared to rural areas was found (see Figure 3). While the crude lifetime diagnostic prevalence for Manitoba young adults in the 2008/09 fiscal year was highest in young adults who lived in Churchill (9.80%, or 15 of 153 young adults), this is likely an artifact of the small population size in this region and the geographical mobility of this age group. Otherwise, Winnipeg had the next highest prevalence of ADHD (8.15%, or 9,443 of 115,934 young adults), followed by Brandon (7.88%, or 739 of 9,375 young adults), Interlake (6.74%, or 841 of 12,472 young adults), then Assiniboine (6.18%, or 677 of 10,959 young adults), North Eastman (6.11%, or 404 of 6,612 young adults), Central (5.74%, or 1,089 of 18,985 young adults), South Eastman (5.65%, or 683 of 12,096 young adults), Parkland (5.11%, or 332 of 6,494 young adults), Nor-Man (4.03%, or 174 of 4,318 children) and finally Burntwood (3.60%, or 365 of

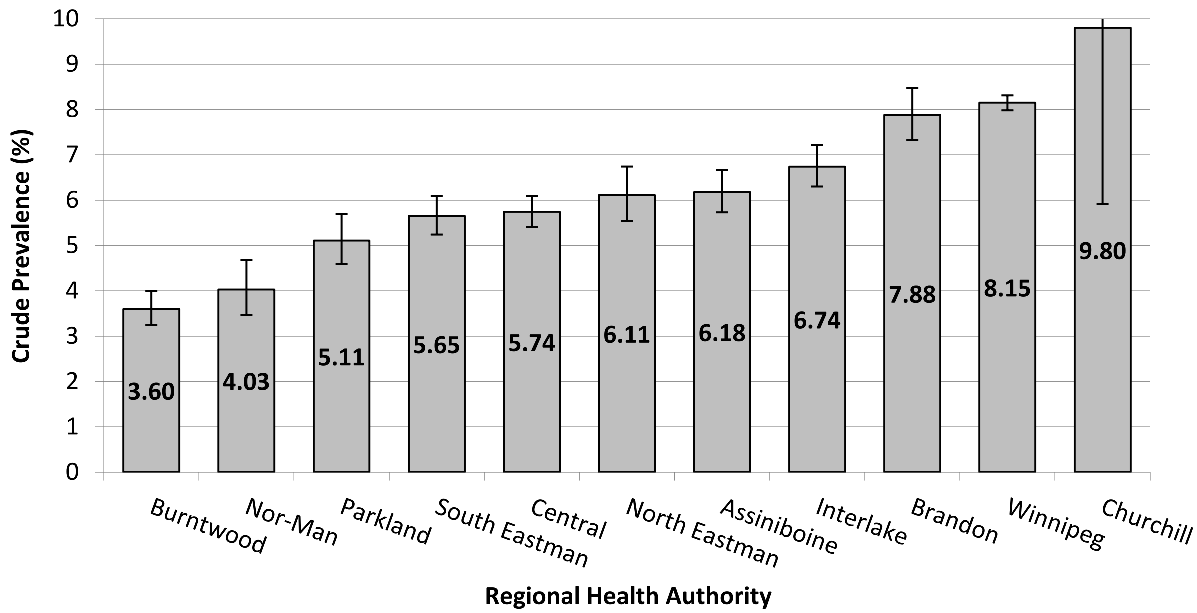
10,146 young adults) [see Figure 4].[1] For a labeled map of the regions used in this analysis, see Appendix D.

Figure 3. Crude prevalence of lifetime ADHD diagnosis by geographical region in Manitoba young adults in 2008/09



[1] During the analyses of this research project, the Regional Health Authorities (RHAs) were amalgamated into larger regions than those used in this study. However, the prevalence for the new regions can be calculated with the information provided in this dissertation paper.

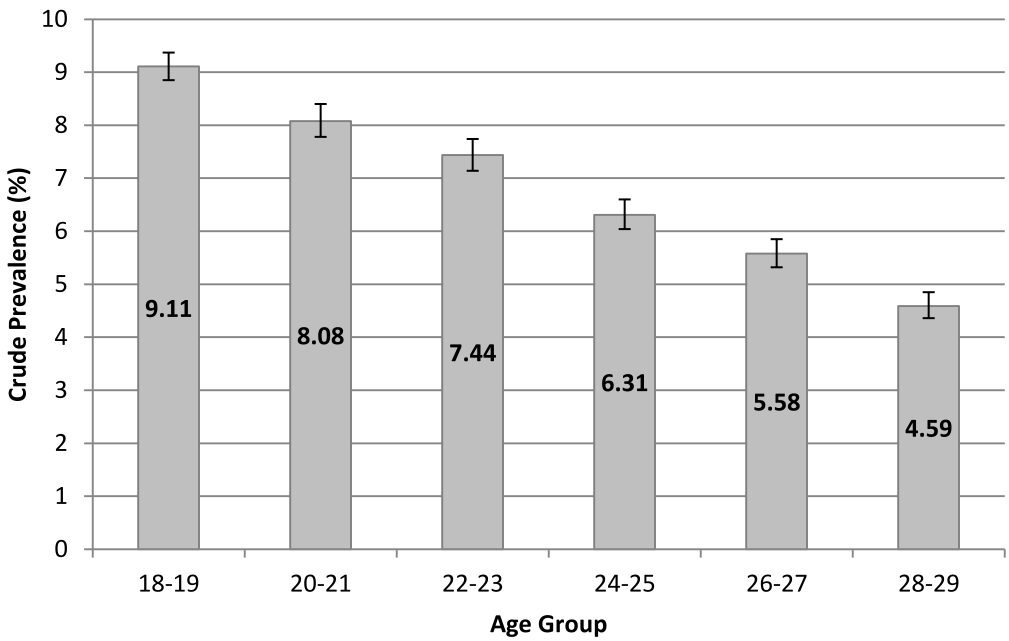
Figure 4. Crude prevalence of lifetime ADHD diagnosis by Regional Health Authority in Manitoba young adults in 2008/09



Age

Lifetime diagnosis crude prevalence by age followed an inverse gradient pattern. The crude diagnostic prevalence for Manitoba young adults in the 2008/2009 fiscal year was highest for the 18- to 19-year-old age group (9.11%, or 4,733 of 51,962 young adults), followed by the 20- to 21-year-old age group (8.08%, or 2,638 of 32,640 young adults), then the 22- to 23-year-old age group (7.44%, or 2,380 of 32,003 young adults), the 24- to 25-year-old age group (6.31%, or 1,959 of 31,028 young adults), the 26- to 27-year-old age group (5.58%, or 1,693 of 30,331 young adults), and finally the 28- to 29-year-old age group (4.59%, or 1,359 of 29,580 young adults) [see Figure 5].

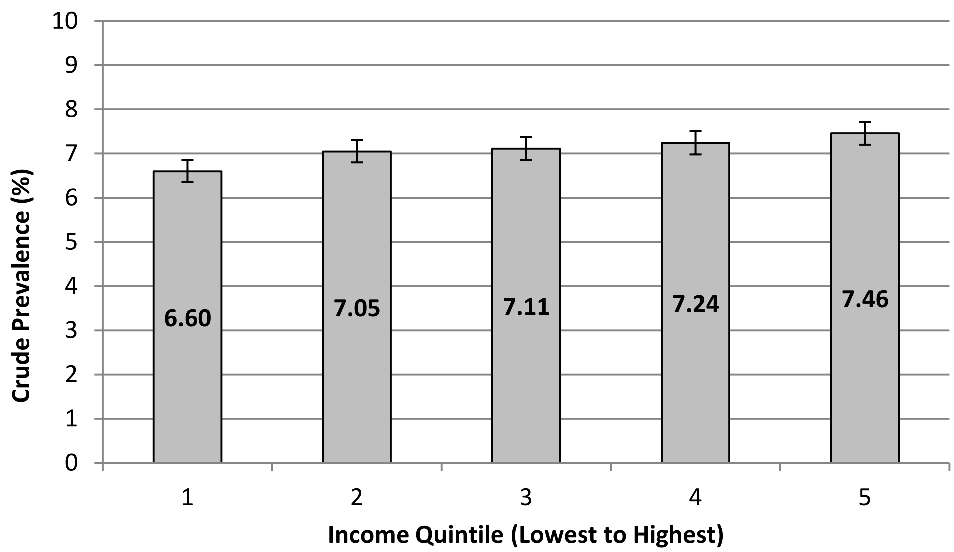
Figure 5. Crude prevalence for lifetime ADHD diagnosis by age group in Manitoba young adults in 2008/09



Socioeconomic Status

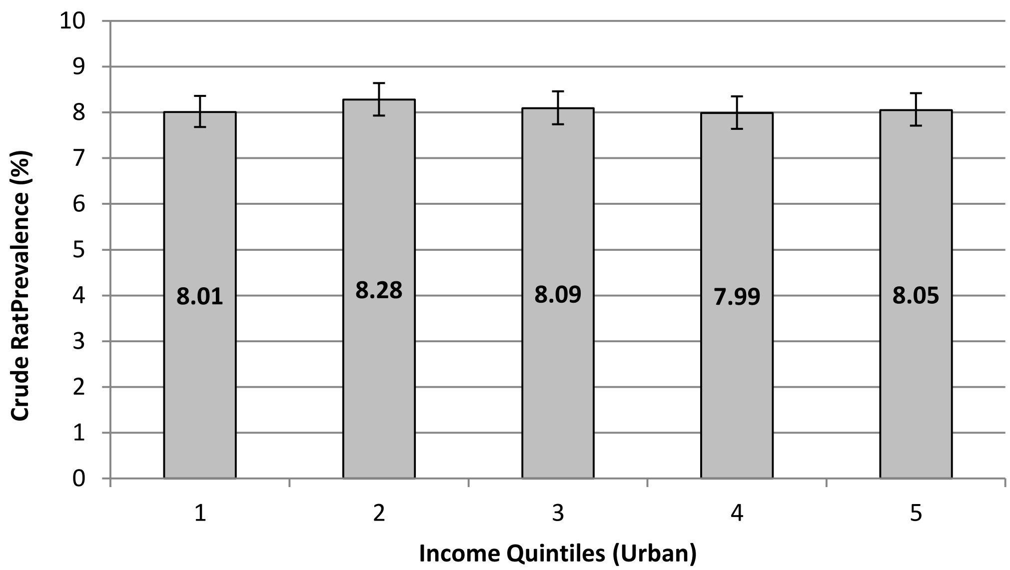
Prevalence of lifetime ADHD diagnosis by income quintile was first considered within the entire population of Manitoba young adults (aged 18 to 29) in the 2008/2009 fiscal year (see Appendix C for a complete listing of crude rates). There were 109 individuals in the ADHD cohort out of 715 in the general population (or, 15.24%) for whom income quintiles could not be determined from Census data because they were: registered under the Manitoba Public Trustee; residents of long-term care facilities; residents of some personal care homes; residents of psychiatric facilities; federal and long-term prisoners; residents of various areas reporting no income in the Census; residents of new neighborhoods (with postal codes that are presently unregistered in the postal code conversion file used to create income quintiles in this study); or residents from dissemination areas with populations less than 250 persons (due to suppression). In all subsequent analyses of SES, these observations were excluded. Crude prevalence for diagnosis according to income quintile across all regions of residence were 6.60%, 7.05%, 7.11%, 7.24%, and 7.46% for Q1 through Q5, respectively. As can be observed in Figure 6, a slight direct gradient pattern emerged at this level of analysis.

Figure 6. Crude prevalence of lifetime ADHD diagnosis in Manitoba young adults by income quintile in 2008/09



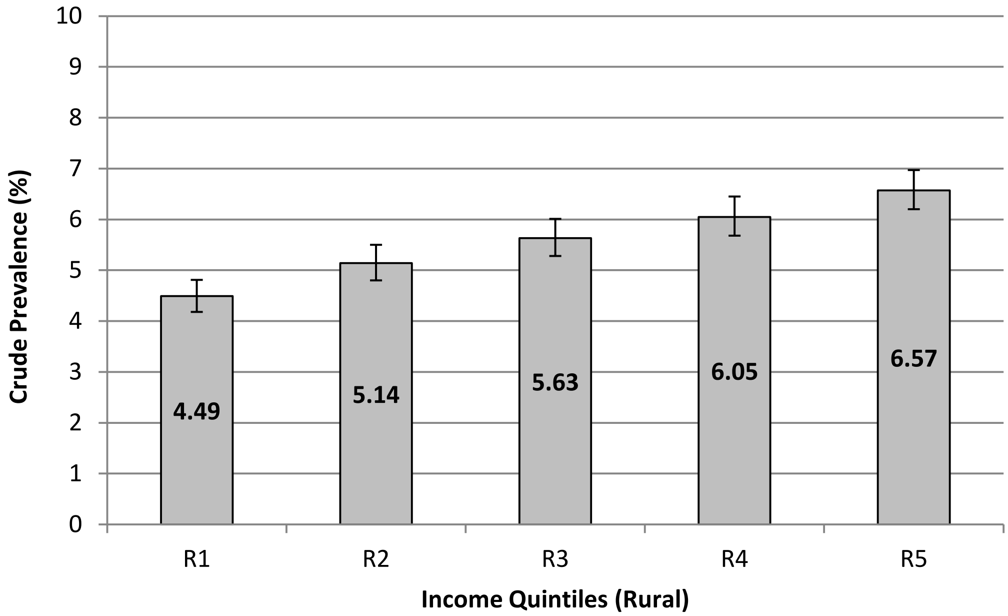
Income quintiles were then split into urban and rural geographical location and crude prevalence was determined separately for each. The crude diagnostic prevalence for Urban Manitoba young adults (aged 18 to 29) in the 2008/2009 fiscal year was highest in young adults in the second lowest income quintile (U2; 8.28%, or 2,078 of 25,101 young adults), followed by the middle quintile (U3; 8.09%, or 1,940 of 23,974 young adults), then the highest quintile (U5; 8.05%, or 1,988 of 24,681 young adults), the lowest quintile (U1; 8.01%, or 2,096 of 26,155 young adults), and finally the fourth highest quintile (U4; 7.99%, or 1,987 of 24,875 young adults). As can be observed in Figure 7, no distinct patterns emerged at this level of analysis.

Figure 7. Crude prevalence of lifetime ADHD diagnosis in urban Manitoba young adults by income quintile in 2008/09



The crude diagnostic prevalence for Rural Manitoba young adults (aged 18 to 29) in the 2008/2009 fiscal year was highest in young adults in the highest income quintile (R5; 6.57%, or 1,101 of 16,747 young adults), followed by the second highest quintile (R4; 6.05%, or 944 of 15,597 young adults), then the middle quintile (R3; 5.63%, or 902 of 16,017 young adults), the second lowest quintile (R2; 5.14%, or 832 of 16,184 young adults), and finally the lowest quintile (R1; 4.49%, or 785 of 17,498 young adults). As can be seen in Figure 8, there is a direct gradient pattern at this level of analysis.

Figure 8. Crude prevalence of lifetime ADHD diagnosis in rural Manitoba young adults by income quintile in 2008/09

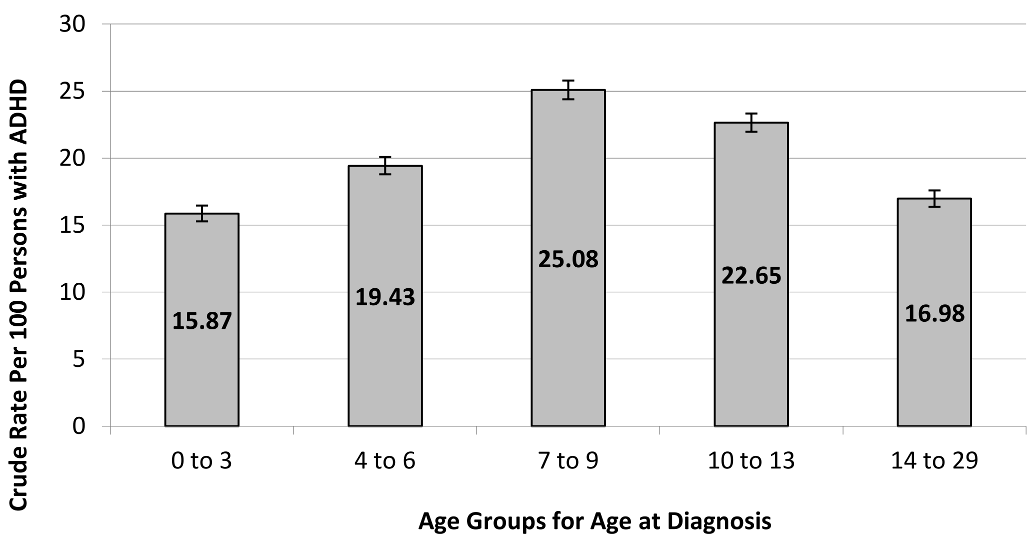


Age at Diagnosis

Crude proportions for age at first recorded diagnosis were calculated using the proportion diagnosed with ADHD at each age group (i.e., 0 to 3, 4 to 6, 7 to 9, 10 to 13, 14 to 29) as the numerator, and the total number with ADHD as the denominator (n = 14,762; see Figure 9). The crude diagnostic proportion for Manitoba young adults in the 2008/2009 fiscal year with a lifetime diagnosis of ADHD was highest for those diagnosed at 7 to 9 years of age (25.08%, or 3,703 of 14,762 young adults with ADHD), followed by 10 to13 years of age (22.65%, or 3,343 of 14,762 young adults with ADHD), then 4 to 6 years of age (19.43%, or 2,868 of 14,762 young adults with ADHD), 14 to 29 years of age (16.98%, or 2,506 of 14,762 young adults with ADHD), and finally 0 to 3years of age (15.87%, or 2,342 of 14,762 young adults with ADHD). Furthermore, 5.45% of Manitoba young adults in the 2008/2009 fiscal year with a lifetime diagnosis of

ADHD (or, 804 of 14,762 young adults with ADHD) were diagnosed at ages 18 to 29 years of age.

Figure 9. Crude prevalence for lifetime ADHD diagnosis by age at diagnosis in Manitoba young adults in 2008/09



Psychostimulant Treatment

The crude prevalence for lifetime treatment during this time period was 3.09%, with 6,403 Manitoba young adults receiving two or more prescriptions for a psychostimulant medication out of the total provincial child population of 207,544. See Table 1 below for psychostimulant crude prevalence results according to age at treatment.

Table 1

Crude prevalence for psychostimulant treatment of ADHD across total population of Manitoba young adults (aged 18 to 29) in the 2008/2009 fiscal year according to age at treatment

ADHD Prescriptions:	**Number with ADHD**	**General Population**	**Crude prevalence (Per 100 Persons)**	**Lower Confidence Interval**	**Upper Confidence Interval**
Ever Received	6403	207544	3.09	3.01	3.16
During Childhood	5202	207544	2.51	2.44	2.57
During Adulthood	1490	207544	0.72	0.68	0.76
During Childhood Only	4913	207544	2.37	2.30	2.43
During Adulthood Only	1201	207544	0.58	0.55	0.61

Accordingly, the crude proportion for lifetime treatment for those with an ADHD diagnosis during this time period was 43.41%, with 6,403 Manitoba young adults receiving two or more prescriptions for a psychostimulant medication out of 14,762 young adults with ADHD. See Table 2 below for psychostimulant proportion rate results according to age at treatment.

Table 2

Crude proportions for psychostimulant treatment of ADHD across cohort of Manitoba young adults (aged 18 to 29) in the 2008/2009 fiscal year with a lifetime diagnosis of ADHD according to age at treatment

ADHD Prescriptions:	**Number Prescribed ADHD Prescriptions**	**Crude prevalence (Per 100 Persons) with ADHD (n=14,762)**	**Lower Confidence Interval**	**Upper Confidence Interval**
Ever Received	6403	43.37	42.57	44.18
During Childhood	5202	35.24	34.47	36.02
During Adulthood	1490	10.09	9.61	10.58
During Childhood Only	4913	33.28	32.52	34.05
During Adulthood Only	1201	8.14	7.7	8.59

Socioeconomic Gradient Analysis

ADHD diagnosis modeling was conducted for: the entire ADHD cohort (with a six-level age group variable); the entire ADHD cohort (with a three-level age group variable);an urban only cohort from within the ADHD cohort (with a six-level age group variable); and an urban only cohort from within the ADHD cohort (with a three-level age group variable). A diagnosis of ADHD was the dependent variable in all regression models. Goodness of fit was assessed using the ratio of model deviance to degrees of freedom, which tests equality of the mean and the variance (with acceptable fit evidenced by a ratio close to 1; Boyle, Flowerdew, & Williams, 1997). The significance of each of the variables in the model was assessed using likelihood ratio tests and the significance of the estimates for each level within all variables was assessed via $\chi 2$ contrasts. A series of sequential models were used, with interactions added separately to the base models, because of a priori theoretical findings that support the main effects, in conjunction with fewer past studies supporting all of the interactions.

For the modeling done across both rural and urban Manitoba regions, negative binomial regression analyses were conducted instead of Poisson regression analyses because preliminary analyses using Poisson models for these rates suggested significant over-dispersion of the data (i.e., variance larger than the mean) and poor model fit. For modeling done with the urban only population within the ADHD cohort, Poisson regression analyses were used because over-dispersion was not observed.

Urban only modeling was also done to test the age group* income quintile interaction because income quintile rates have been found to consistently differ between urban and rural regions in previous research on ADHD in Manitoba (Brownell &

Yogendran, 2005, Yallop, 2008). Rural data is more likely to have inconsistencies due to incomplete data from nursing stations, reduced access to particular health professionals, and more within-area heterogeneity in SES. Therefore, confirming whether there are similar results from modeling the interaction using the total population versus the urban only population lends support to model interpretation.

Diagnosis Modeling Using Total ADHD Cohort and a Six-Level Age Group Variable:

For the diagnosis modeling using the total ADHD cohort and a six-level age group variable (i.e., 18 to 19, 20 to 21, 22 to 23, 24 to 25, 26 to 27 and 28 to 29 years), the base model included the main effects of sex, geographical location of residence (urban versus rural), age group, and income quintile. The deviance to degrees of freedom ratio for this model was 1.16 and the likelihood ratio statistics indicated that with the exception of income quintile, all independent variables were statistically significant (see Tables 3). Table 4 provides the regression coefficient contrast estimates for the covariates that were significant in the likelihood ratio statistics.

Table 3

Likelihood Statistics of ADHD diagnosis for Base Model a

Source	**DF**	**$\chi 2$**	**p-value**	**Value/DF**
Sex	1	321.63	<.0001	1.16
Region of Residence (Urban/Rural)	1	154.00	<.0001	
Age Group	5	174.83	<.0001	
Income Quintile	4	5.95	0.2027	

Table 4

Regression Coefficient Estimates of ADHD diagnosis for Base Model a

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.99	2.69	(2.57-2.82)	1749.05	<0.0001
Female	Ref	---	---	---	---
Region of Residence					
Rural	-0.43	0.65	(0.62-0.68)	332.03	<0.0001
Urban	Ref	---	---	---	---
Age Group					
Age Group 1: 18 - 19	0.72	2.05	(1.89-2.21)	316.21	<0.0001
Age Group 2: 20 - 21	0.59	1.80	(1.66-1.96)	192.85	<0.0001
Age Group 3: 22 - 23	0.50	1.65	(1.52-1.8)	137.27	<0.0001
Age Group 4: 24 - 25	0.33	1.39	(1.28-1.52)	55.88	<0.0001
Age Group 5: 26 - 27	-0.09	0.92	(0.86-0.99)	5.60	0.0180
Age Group 6: 28 - 29	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the region of residence* income quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 1.04 and the likelihood ratio statistics showed that all independent variables were significant (see Tables 5 and 6). The addition of this interaction improved overall model fit. Table 6 provides the regression coefficient contrast estimates, including a significant linear trend for the region of residence* income quintile interaction.

Table 5

Likelihood Statistics of ADHD diagnosis for Model1a

Source	DF	$\chi 2$	p-value	Value/DF
Sex	1	388.76	<.0001	1.04
Region of Residence (Urban/Rural)	1	210.63	<.0001	
Age Group	5	233.67	<.0001	
Income Quintile	4	25.55	<.0001	
Region of Residence (Urban/Rural)* Income Quintile	4	70.76	<.0001	

Table 6

Regression Coefficient Estimates of ADHD diagnosis for Model1a

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.99	2.69	(2.59-2.79)	2799.69	<0.0001
Female	Ref	---	---	---	---
Age Group					
Age Group 1: 18 - 19	0.72	2.05	(1.93-2.18)	537.05	<0.0001
Age Group 2: 20 - 21	0.60	1.82	(1.7-1.94)	315.56	<0.0001
Age Group 3: 22 - 23	0.51	1.66	(1.55-1.78)	221.14	<0.0001
Age Group 4: 24 - 25	0.33	1.39	(1.3-1.49)	87.15	<0.0001
Age Group 5: 26 - 27	0.20	1.22	(1.14-1.32)	30.58	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---	---
Region of Residence* Income Quintile					
Rural: Q1	-0.37	0.69	(0.63-0.76)	62.91	<0.0001
Rural: Q2	-0.23	0.79	(0.72-0.87)	25.68	<0.0001
Rural: Q3	-0.13	0.87	(0.8-0.95)	8.94	0.0028
Rural: Q4	-0.07	0.93	(0.86-1.02)	2.34	0.1260
Rural: Q5	Ref	---	---	---	---
Linear trend	0.30	1.35	(1.26-1.45)	74.70	<0.0001
Urban: Q1	0.10	1.11	(1.04-1.18)	9.94	0.0016
Urban: Q2	0.11	1.11	(1.05-1.19)	11.06	0.0009
Urban: Q3	0.06	1.06	(0.99-1.13)	3.08	0.0793
Urban: Q4	0.01	1.01	(0.95-1.08)	0.13	0.7224
Urban: Q5	Ref	---	---	---	---
Linear trend	-0.10	0.91	(0.86-0.95)	17.21	<0.0001

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the age group* income quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 1.42. The likelihood ratio statistics showed that this interaction was not significant and the addition of this interaction decreased overall model fit (see Tables 7). Table 8 provides the regression coefficient contrast estimates for the covariates that were significant in the likelihood ratio statistics. Overall, the best fitting model using the total ADHD cohort and the six-level age variable included: sex, region, age, income quintile and a region* income quintile interaction.

Table 7

Likelihood Statistics of ADHD diagnosis for Model 2a

Source	DF	$\chi 2$	p-value	Value/DF
Sex	1	334.15	<.0001	1.42
Region of Residence (Urban/Rural)	1	163.94	<.0001	
Age Group	5	185.27	<.0001	
Income Quintile	4	7.54	0.1099	
Age Group* Income Quintile	20	13.49	0.8553	

Table 8

Regression Coefficient Estimates of ADHD diagnosis for Model 2a

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.9904	2.6924	(2.58-2.81)	1952.43	<0.0001
Female	Ref	---	---	---	---
Region of Residence					
Rural	-0.4256	0.6534	(0.63-0.68)	372.78	<0.0001
Urban	Ref	---	---	---	---
Age Group					
Age Group 1: 18 - 19	0.7189	2.0522	(1.9-2.21)	355.92	<0.0001
Age Group 2: 20 - 21	0.5904	1.8047	(1.67-1.95)	213.81	<0.0001
Age Group 3: 22 - 23	0.5058	1.6583	(1.53-1.8)	153.08	<0.0001
Age Group 4: 24 - 25	0.3319	1.3936	(1.28-1.51)	62.23	<0.0001
Age Group 5: 26 - 27	0.2057	1.2284	(1.13-1.34)	22.83	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Diagnosis Modeling Using Total ADHD Cohort and a Three-Level Age Group Variable:

For the diagnosis modeling using the total ADHD cohort and a three-level age group variable (i.e., 18 to 21, 22 to 25, and 26 to 29 years), the base model also included the main effects of sex, geographical location of residence (urban versus rural), age group, and income quintile. This analysis was conducted to determine whether reducing the number of levels in the model contributed by the age group variable would have an impact on model fit.

For the base model, the deviance to degrees of freedom ratio for this model was 1.23 and the likelihood ratio statistics indicated that with the exception of income quintile, all independent variables were statistically significant (see Table 9). Table 10 provides the regression coefficient contrast estimates for the covariates that were significant in the likelihood ratio statistics.

Table 9

Likelihood Statistics of ADHD diagnosis for Base Model b

Source	DF	χ2	p-value	Value/DF
Sex	1	185.13	<.0001	1.23
Region of Residence (Urban/Rural)	1	94.98	<.0001	
Age Group	2	102.94	<.0001	
Income Quintile	4	5.39	0.2494	

Table 10

Regression Coefficient Estimates of ADHD diagnosis for Base Model b

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.99	2.70	(2.56-2.85)	1322.5	<0.0001
Female	Ref	---	---	---	---
Region of Residence					
Rural	-0.42	0.66	(0.62-0.69)	243.67	<0.0001
Urban	Ref	---	---	---	---
Age Group					
18 - 21	0.56	1.75	(1.64-1.87)	290.12	<0.0001
22 - 25	0.32	1.37	(1.28-1.47)	83.18	<0.0001
26 - 29	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the region of residence* income quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 0.98 and the likelihood ratio statistics showed that all independent variables were significant (see Table 11). The addition of this interaction improved overall model fit. Table 12 provides the regression coefficient contrast estimates, including a significant linear trend for the region of residence* income quintile interaction.

Table 11

Likelihood Statistics of ADHD diagnosis for Model1b

Source	DF	χ2	p-value	Value/DF
Sex	1	243.70	<.0001	0.98
Region of Residence (Urban/Rural)	1	147.14	<.0001	
Age Group	2	156.08	<.0001	
Income Quintile	4	25.68	<.0001	
Region of Residence (Urban/Rural)* Income Quintile	4	60.39	<.0001	

Table 12

Regression Coefficient Estimates of ADHD diagnosis for Model1b

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.9893	2.6893	(2.59-2.79)	2778.49	<0.0001
Female	Ref	---	---	---	---
Age Group					
18 - 21	0.5661	1.7615	(1.69-1.84)	678.14	<0.0001
22 - 25	0.3169	1.3729	(1.31-1.44)	177.99	<0.0001
26 - 29	Ref	---	---	---	---
Region of Residence* Income Quintile					
Rural: Q1	-0.3704	0.6904	(0.63-0.76)	62.78	<0.0001
Rural: Q2	-0.2344	0.7911	(0.72-0.87)	25.60	<0.0001
Rural: Q3	-0.1365	0.8724	(0.8-0.95)	8.96	0.0028
Rural: Q4	-0.0692	0.9332	(0.85-1.02)	2.39	0.1222
Rural: Q5	Ref	---	---	---	---
Linear trend	-0.3020	1.4485	(1.26-1.45)	74.60	0.0001
Urban: Q1	0.0951	1.0998	(1.03-1.17)	8.80	0.0030
Urban: Q2	0.1026	1.1081	(1.04-1.18)	9.74	0.0018
Urban: Q3	0.0557	1.0573	(0.99-1.13)	2.60	0.1065
Urban: Q4	0.0099	1.0100	(0.95-1.08)	0.09	0.7629
Urban: Q5	Ref	---	---	---	---
Linear trend	-0.0943	0.9536	(0.87-0.95)	15.58	0.0001

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the age group* income quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 1.43. The likelihood ratio statistics showed that this interaction was not significant and the addition of this interaction decreased overall model fit (see Tables 13 and 14). Table 14 provides the regression coefficient contrast estimates for the covariates that were significant in the likelihood ratio statistics. Overall, we can see that replacing the six-level age group variable with a three-level age group variable had minimal impact on the model fit. This suggests that these results accurately reflect the relationship between ADHD diagnosis and the variables in these models.

Table 13

Likelihood Statistics of ADHD diagnosis for Model 2b

Source	**DF**	**χ2**	**p-value**	**Value/DF**
Sex	1	187.53	<.0001	1.43
Region of Residence (Urban/Rural)	1	96.80	<.0001	
Age Group	2	104.68	<.0001	
Income Quintile	4	6.47	0.1667	
Age Group* Income Quintile	8	2.62	0.9557	

Table 14

Regression Coefficient Estimates of ADHD diagnosis for Model 2b

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.9924	2.70	(2.56-2.84)	1357.00	<0.0001
Female	Ref	---	---	---	---
Region of Residence					
Rural	-0.4236	0.65	(0.62-0.69)	250.96	<0.0001
Urban	Ref	---	---	---	---
Age Group					
1: 18 - 21	0.5616	1.75	(1.65-1.87)	297.33	<0.0001
2: 22 - 25	0.3148	1.37	(1.28-1.46)	84.79	<0.0001
3: 26 - 29	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Diagnosis Modeling Using Urban Only ADHD Cohort and a Six-Level Age Group Variable

For the diagnosis modeling using the urban only ADHD cohort and a six-level age group variable (i.e., 18 to 19, 20 to 21, 22 to 23, 24 to 25, 26 to 27, and 28 to 29 years), the base model included the main effects of sex, age group, and income quintile. The deviance to degrees of freedom ratio for this model was 1.23 and the likelihood ratio statistics indicated that all independent variables were statistically significant (see Table 15). Table 16 provides the regression coefficient contrast estimates, including a significant linear trend for income quintile.

Table 15

Likelihood Statistics of ADHD diagnosis for Base Model c

Source	DF	χ2	p-value	Value/DF
Sex	1	2161.89	<.0001	1.23
Age Group	5	595.13	<.0001	
Income Quintile	4	20.11	0.0005	

Table 16

Regression Coefficient Estimates of ADHD diagnosis for Base Model c

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.98	2.67	(2.55-2.78)	1926.02	<0.0001
Female	Ref	---	---	---	---
Age Group					
Age Group 1: 18 - 19	0.73	2.07	(1.93-2.23)	394.08	<0.0001
Age Group 2: 20 - 21	0.62	1.87	(1.73-2.02)	245.36	<0.0001
Age Group 3: 22 - 23	0.53	1.70	(1.57-1.84)	171.80	<0.0001
Age Group 4: 24 - 25	0.33	1.39	(1.28-1.51)	61.87	<0.0001
Age Group 5: 26 - 27	0.22	1.25	(1.15-1.36)	26.64	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---	---
Income Quintile					
Q1	0.10	1.11	(1.04-1.18)	10.63	0.0011
Q2	0.11	1.11	(1.05-1.19)	11.81	0.0006
Q3	0.06	1.06	(1-1.13)	3.49	0.0619
Q4	0.01	1.01	(0.95-1.08)	0.14	0.7105
Q5	Ref	---	---	---	---
Linear trend	-0.30	0.74	(0.64-0.85)	18.30	<0.0001

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the Age Group* Income Quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 1.14 and the likelihood ratio statistics showed that this interaction was not significant, although the addition of this interaction increased overall model fit (see Tables 17). Table 18 provides the regression coefficient contrast estimates, including a non-significant linear trend for the age group * income quintile interaction.

Table 17

Likelihood Statistics of ADHD diagnosis for Model 2c

Source	DF	χ2	p-value	Value/DF
Sex	1	2157.50	<.0001	1.14
Age Group	5	589.64	<.0001	
Income Quintile	4	12.04	0.017	
Age Group* Income Quintile	20	27.28	0.1277	

Table 18

Regression Coefficient Estimates of ADHD diagnosis for Model 2c

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.98	2.66	(2.55-2.78)	1922.34	<0.0001
Female	Ref	---	---	---	---
Age Group					
Age Group 1: 18 - 19	0.74	2.09	(1.94-2.25)	384.96	<0.0001
Age Group 2: 20 - 21	0.63	1.88	(1.73-2.03)	239.43	<0.0001
Age Group 3: 22 - 23	0.54	1.71	(1.58-1.86)	169.03	<0.0001
Age Group 4: 24 - 25	0.34	1.40	(1.29-1.52)	62.23	<0.0001
Age Group 5: 26 - 27	0.24	1.27	(1.16-1.38)	29.56	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---	---
Income Quintile					
Q1	0.07	1.07	(1-1.14)	3.79	0.0516
Q2	0.09	1.09	(1.02-1.17)	6.49	0.0109
Q3	0.03	1.03	(0.96-1.1)	0.65	0.4191
Q4	-0.01	0.99	(0.93-1.06)	0.05	0.8207
Q5	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Diagnosis Modeling Using Urban Only ADHD Cohort and a Three-Level Age Group Variable

For the diagnosis modeling using the urban only ADHD cohort and a three-level age group variable (i.e., 18 to 21, 22 to 25, and 26 to 29 years), the base model also included the main effects of sex, age group, and income quintile. For the base model, the deviance to degrees of freedom ratio was 1.09 and the likelihood ratio statistics indicated that all independent variables were statistically significant (see Table 19). Table 20 provides the regression coefficient contrast estimates, including a significant linear trend for income quintile.

Table 19

Likelihood Statistics of ADHD diagnosis for Base Model d

Source	DF	$\chi 2$	p-value	Value/DF
Sex	1	2162.37	<.0001	1.09
Age Group	2	525.46	<.0001	
Income Quintile	4	18.08	0.0012	

Table 20

Regression Coefficient Estimates of ADHD diagnosis for Base Model d

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.98	2.67	(2.55-2.78)	1926.40	<0.0001
Female	Ref	---	---	---	---
Age Group					
18 - 21	0.57	1.77	(1.68-1.86)	492.06	<0.0001
22 - 25	0.32	1.37	(1.3-1.45)	126.93	<0.0001
26 - 29	Ref	---	---	---	---
Income Quintile					
Q1	0.10	1.10	(1.03-1.17)	9.24	0.0024
Q2	0.10	1.11	(1.04-1.18)	10.73	0.0011
Q3	0.06	1.06	(0.99-1.13)	3.08	0.0795
Q4	0.01	1.01	(0.95-1.08)	0.10	0.7481
Q5	Ref	---	---	---	---
Linear test	-0.28	0.75	(0.66-0.86)	16.27	<0.0001

**RR refers to Relative Risk; **CI refers to Confidence Interval*

Next, the Age Group* Income Quintile interaction was added to the base model. The deviance to degrees of freedom ratio with the interaction added was 1.09 and the likelihood ratio statistics showed that this interaction was not significant. The addition of this interaction had no impact on overall model fit (see Table 21). Table 22 provides the regression coefficient contrast estimates, including a non-significant linear trend for the age group* income quintile interaction.

Table 21

Likelihood Statistics of ADHD diagnosis for Model 2d

Source	DF	χ2	p-value	Value/DF
Sex	1	2158.51	<.0001	1.09
Age Group	2	515.00	<.0001	
Income Quintile	4	10.75	0.0295	
Age Group* Income Quintile	8	8.77	0.3625	

Table 22

Regression Coefficient Estimates of ADHD diagnosis for Model 2d

Model Effect	Estimate	RR*	95% CI**	χ^2	p-value
Sex					
Male	0.98	2.66	(2.55-2.78)	1923.15	<0.0001
Female	Ref	---	---	---	---
Age Group					
1: 18 - 21	0.57	1.76	(1.68-1.86)	478.59	<0.0001
2: 22 - 25	0.31	1.36	(1.29-1.44)	120.74	<0.0001
3: 26 - 29	Ref	---	---	---	---
Income Quintile					
Q1	0.07	1.07	(1-1.14)	3.80	0.0513
Q2	0.08	1.08	(1.02-1.16)	5.84	0.0157
Q3	0.03	1.03	(0.96-1.1)	0.81	0.3671
Q4	-0.01	0.99	(0.93-1.06)	0.02	0.8805
Q5	Ref	---	---	---	---

**RR refers to Relative Risk; **CI refers to Confidence Interval*

In summary, we can see that even within the urban only population, replacing the six-level age group variable with a three-level age group variable had no impact on the model fit, and the age group* income quintile interaction was still not significant. Therefore, it can be concluded that: the region of residence* income quintile interaction was significant, the age group* income quintile interaction was not significant (within the total population or the urban only population), the use of a three-level vs. a six-level age group variable does not change the overall findings, and the best fitting model was: sex, region, age group (six-level), income quintile and a region* income quintile interaction within the total population (see Tables 5 and 6).

Age at Diagnosis Income Quintile Logistic Regression Analysis*

To test for an interaction between income quintile and age at diagnosis in childhood versus young adulthood (i.e., diagnosed before age 18 versus diagnosed between ages 18 to 29), logistic regression modeling was used (see Table 23 below) within the ADHD cohort only. Only the ADHD cohort was used in this regression analysis because there is no age at diagnosis variable for the general population (i.e., they do not have ADHD diagnoses). As evidenced by the non-significant linear trend ($p = 0.061$) in Table 23, the relationship between age at diagnosis and income quintile did not form a linear gradient pattern, such that for every unit increase in quintile (i.e., from Q1 to Q2, Q2 to Q3, etc.), there is an increase in odds of being diagnosed before age 18, versus at ages 18 to 29. Instead, the odds ratio of income quintile comparisons in Table 24 demonstrated that there were no statistically significant differences between the rates of diagnosis in adulthood within the first four income quintiles (all compared to Q3, as this was the highest value), and the rate for the highest income quintile (Q5) was significantly lower than all other income quintiles. In other words, individuals from the very highest income quintile were significantly less likely to be diagnosed before age 18 compared to all other income quintiles. It is also interesting to note that males were significantly more likely than females to be diagnosed before age 18 and those living in urban areas were significantly less likely to be diagnosed before age 18 than those living in rural areas (see Table 23).

Table 23

Odds ratios for logistic regression modeling of age at diagnosis (under age 18)

Effect		**OR (95% CI)**	***P***
Sex			
	Female	*Reference*	
	Male	2.329 (2.015, 2.691)	<0.0001
Region of Residence			
	Urban	*Reference*	
	Rural	1.327 (1.127, 1.563)	0.001
Income Quintile			
	Q1	1.245 (1.002, 1.547)	0.048
	Q2	1.233 (0.992, 1.532)	0.059
	Q3	1.453 (1.155, 1.827)	0.001
	Q4	1.195 (0.963, 1.484)	0.106
	Q5	*Reference*	
	Linear trend	0.86	0.061

Table 24

Odds ratios of income quintile comparisons for logistic regression modeling of age at diagnosis

(under age 18)

Effect	**OR (95% CI)**	***p***
Q1 vs. Q3	1.167 (0.918, 1.483)	0.2070
Q2 vs. Q3	1.178 (0.927, 1.498)	0.1801
Q3 vs. Q4	0.823 (0.648, 1.045)	0.1103
Q1 vs. Q5	0.803 (0.647, 0.998)	0.0476
Q1234 vs. Q5	0.783 (0.662, 0.925)	0.0040

Matched Cohort Analysis

The relationship between ADHD diagnosis and service utilization was explored with a matched cohort design, using both a general population comparison group and an asthma comparison group (an ADHD with no comorbid asthma cohort vs. asthma cohort analysis was also conducted, to ensure that the presence of asthma in the case group was not influencing the results). The case and comparison groups were matched on sex, age group and three-digit postal codes, with up to four-to-one matching (see Appendix E for tables with crude frequencies and percentages of matching ratios for each set of analyses). The analyses for high school graduation were done separately, as education data were not available for the entire study population (~20% of the ADHD cohort). The missing data included: students who skipped grade nine, students who dropped out of school before grade nine, some students who enrolled in a First Nations school, some students who were home schooled, and youth who moved in or out of the province within the study period, such that their education records were incomplete. Observations with missing high school graduation data were deleted before the match analyses were conducted, as the regression analyses could not be conducted on missing data.

A generalized estimating equation (GEE) regression analysis with a Poisson distribution was used to test for differences in the relative rates between the case and comparison groups, after controlling for confounding covariates. GEE was selected because it provides parameter estimation for correlated data and matched datasets are inherently correlated. If this correlation was not accounted for, then the standard errors of the parameter estimates would be non-replicable and non-valid. Covariates added to each of the models were: sex, age group, and income quintile, as these variables commonly contribute to the variance in the models of each outcome variable. Likelihood ratio tests were not applied to the models because there is no associated likelihood underlying the model (Hardin & Hilbe, 2003). Service utilization analyses included: depression, anxiety, personality disorders, conduct disorder, substance abuse, income assistance, high school graduation, and several categories of injury hospitalizations. Crude prevalence and rates of outcome variables by case for each of the matched cohort analyses are provided in tables in Appendices F, G, and H. Please note that the tables for injury count variables in Appendices F, G, and H have been summarized to suppress values of five or less. See Table 97 at the end of this section for an overview of the relative rates for each outcome variable, across all matched cohort analyses (with all other covariate information removed to provide a more parsimonious overview of the results).

ADHD: General Population Matched Cohort Analysis

As can be observed in Table 25, the Type 3 GEE statistics indicated that, with the exception of income quintile, all model covariates for the depression analysis were statistically significant. The relative rate of depression in the ADHD cohort is 6.79 times higher than that of the general population (see Table 26). Furthermore, the prevalence of depression is significantly higher in females, and incrementally increases with age (see Table 26).

Table 25

Type 3 GEE statistics for ADHD: general population matched cohort depression analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	289.37	<.0001
Sex	1	285.66	<.0001
Age Group	5	85.00	<.0001
Income Quintile	4	32.45	0.2264

Table 26

Relative Rates for ADHD: general population matched cohort depression analysis

Model Effect	**RR***	**95% CI****	χ^2	**p-value**
Case	6.79	(6.33-7.27)	2934.53	<0.0001
Sex				
Male	0.40	(0.38-0.43)	666.05	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.57	(0.5-0.64)	90.70	<0.0001
Age Group 2: 20 - 21	0.63	(0.55-0.71)	48.52	<0.0001
Age Group 3: 22 - 23	0.78	(0.7-0.88)	16.47	0.0001
Age Group 4: 24 - 25	0.78	(0.68-0.88)	15.85	0.1719
Age Group 5: 26 - 27	0.92	(0.81-1.04)	1.87	0.0376
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that, with the exception of income quintile, all model covariates for the anxiety analysis were statistically significant (see Table 27). The relative rate of anxiety in the ADHD cohort is 6.02 times higher than that of the general population (see Table 28). Furthermore, the relative rate of anxiety is significantly higher in females and incrementally increases with age (see Table 28).

Table 27

Type 3 GEE statistics for ADHD: general population matched cohort anxiety analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	$\chi 2$	**p-value**
Case	1	298.46	<.0001
Sex	1	134.60	<.0001
Age Group	5	88.42	<.0001
Income Quintile	4	5.93	0.2047

Table 28

Relative Rates for ADHD: general population matched cohort anxiety analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	6.02	(5.53-6.55)	1723.41	<0.0001
Sex				
Male	0.47	(0.43-0.51)	267.25	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.45	(0.39-0.53)	98.25	<0.0001
Age Group 2: 20 - 21	0.65	(0.55-0.77)	26.23	<0.0001
Age Group 3: 22 - 23	0.76	(0.65-0.88)	12.59	0.0004
Age Group 4: 24 - 25	0.84	(0.71-1)	3.65	0.0562
Age Group 5: 26 - 27	0.93	(0.78-1.1)	0.79	0.3747
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

As noted in Table 29, the Type 3 GEE statistics indicated that all model covariates for the personality disorders analysis were statistically significant. The relative rate of personality disorders in the ADHD cohort is 15.16 times higher than that of the general population (see Table 30). Furthermore, the relative rate of personality disorders is significantly higher in females and incrementally increases with age up until ages 26 to 27, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 30).

Table 29

Type 3 GEE statistics for ADHD: general population matched cohort personality disorders analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	120.92	<.0001
Sex	1	29.27	<.0001
Age Group	5	11.72	0.0389
Income Quintile	4	9.63	0.0471

Table 30

Relative Rates for ADHD: general population matched cohort personality disorders analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	15.16	(11.17-20.58)	304.71	<0.0001
Sex				
Male	0.45	(0.36-0.57)	43.43	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.61	(0.42-0.89)	6.55	0.0105
Age Group 2: 20 - 21	0.72	(0.48-1.07)	2.70	0.1002
Age Group 3: 22 - 23	0.78	(0.51-1.19)	1.34	0.2474
Age Group 4: 24 - 25	0.89	(0.57-1.39)	0.26	0.6086
Age Group 5: 26 - 27	1.13	(0.76-1.7)	0.37	0.5427
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.75	(1.19-2.58)	8.00	0.0047
Q2	1.47	(0.99-2.19)	3.67	0.0552
Q3	1.13	(0.75-1.71)	0.36	0.5489
Q4	1.26	(0.82-1.92)	1.09	0.2957
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the conduct disorder analysis were statistically significant, with the exception of income quintile (see Table 31). The relative rate of conduct disorder in the ADHD cohort is 25.69 times higher than that of the general population (see Table 32). Furthermore, the relative rate of conduct disorder is significantly higher in females, and incrementally decreases with age (see Table 32).

Table 31

Type 3 GEE statistics for ADHD: general population matched cohort conduct disorder analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	60.69	<.0001
Sex	1	5.93	0.0149
Age Group	5	60.16	<.0001
Income Quintile	4	1.32	0.8583

Table 32

Relative Rates for ADHD: general population matched cohort conduct disorder analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	25.69	(17.33-38.1)	260.75	<0.0001
Sex				
Male	0.61	(0.44-0.86)	8.05	0.0046
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	20.88	(5.38-80.99)	19.31	<0.0001
Age Group 2: 20 - 21	5.78	(1.42-23.47)	6.03	0.0141
Age Group 3: 22 - 23	2.90	(0.67-12.53)	2.04	0.1529
Age Group 4: 24 - 25	2.10	(0.45-9.93)	0.88	0.3477
Age Group 5: 26 - 27	1.62	(0.31-8.47)	0.33	0.5681
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the substance abuse analysis were statistically significant, with the exception of sex (see Table 33). The rate of substance abuse in the ADHD cohort is 7.81 times higher than that of the general population (see Table 34). Furthermore, the relative rate incrementally increases with age, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 34).

Table 33

Type 3 GEE statistics for ADHD: general population matched cohort substance abuse analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	199.44	<.0001
Sex	1	1.26	0.2624
Age Group	5	43.64	<.0001
Income Quintile	4	39.36	<.0001

Table 34

Relative Rates for ADHD: general population matched cohort substance abuse analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	7.81	(6.83-8.94)	902.63	<0.0001
Age Group				
Age Group 1: 18 - 19	0.45	(0.36-0.56)	49.92	<0.0001
Age Group 2: 20 - 21	0.61	(0.49-0.76)	18.65	<0.0001
Age Group 3: 22 - 23	0.68	(0.54-0.87)	9.87	0.0017
Age Group 4: 24 - 25	0.68	(0.54-0.85)	11.75	0.0006
Age Group 5: 26 - 27	0.87	(0.68-1.11)	1.28	0.2572
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.81	(1.5-2.17)	39.26	<0.0001
Q2	1.20	(0.99-1.45)	3.36	0.0669
Q3	1.15	(0.93-1.41)	1.66	0.1973
Q4	0.98	(0.8-1.21)	0.02	0.8820
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the income assistance analysis were statistically significant (see Table 35). The rate of income assistance in the ADHD cohort is 3.40 times higher than that of the general population (see Table 36). Furthermore, the relative rate of income assistance is significantly higher in females, incrementally increases with age, and incrementally decreases with increasing income quintile (see Table 36).

Table 35

Type 3 GEE statistics for ADHD: general population matched cohort income assistance analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ^2	p-value
Case	1	304.70	<.0001
Sex	1	66.91	<.0001
Age Group	5	93.47	<.0001
Income Quintile	4	233.09	<.0001

Table 36

Relative Rates for ADHD: general population matched cohort income assistance analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	3.40	(3.2-3.63)	1442.19	<0.0001
Sex				
Male	0.58	(0.53-0.64)	122.79	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.32	(0.26-0.38)	146.12	<0.0001
Age Group 2: 20 - 21	0.63	(0.53-0.74)	28.00	<0.0001
Age Group 3: 22 - 23	0.67	(0.57-0.79)	22.84	<0.0001
Age Group 4: 24 - 25	0.78	(0.67-0.91)	10.38	0.0013
Age Group 5: 26 - 27	0.91	(0.77-1.07)	1.36	0.2429
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	5.14	(4.6-5.74)	841.99	<0.0001
Q2	2.87	(2.59-3.18)	413.52	<0.0001
Q3	2.19	(1.97-2.42)	224.79	<0.0001
Q4	1.68	(1.51-1.86)	95.70	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the high school graduation analysis were statistically significant (see Table 37). The rate of high school graduation in the ADHD cohort is 0.77 times that of the general population (see Table 38). Furthermore, the relative rate of high school graduation is significantly higher in females, incrementally decreases with age, and incrementally increases with increasing income quintile (see Table 38).

Table 37

Type 3 GEE statistics for ADHD: general population matched cohort high school graduation analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	209.34	<.0001
Sex	1	15.65	0.0001
Age Group	5	48.62	<.0001
Income Quintile	4	160.48	<.0001

Table 38

Relative Rates for ADHD: general population matched cohort high school graduation analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	0.77	(0.76-0.79)	594.46	<0.0001
Sex				
Male	0.95	(0.92-0.97)	17.06	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	2.69	(2.1-3.45)	60.69	<0.0001
Age Group 2: 20 - 21	2.67	(2.08-3.42)	59.62	<0.0001
Age Group 3: 22 - 23	2.66	(2.08-3.41)	59.64	<0.0001
Age Group 4: 24 - 25	2.57	(2-3.29)	55.06	0.0013
Age Group 5: 26 - 27	2.36	(1.84-3.04)	45.22	0.2429
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	0.61	(0.58-0.64)	448.71	<0.0001
Q2	0.80	(0.78-0.82)	261.11	<0.0001
Q3	0.88	(0.87-0.9)	182.49	<0.0001
Q4	0.95	(0.94-0.96)	50.05	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the analysis of one or more hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 39). The rate of one or more hospitalizations for any

type of injury in the ADHD cohort is 1.62 times higher than that of the general population (see Table 40). Furthermore, the relative rate for one or more hospitalizations for injuries is significantly higher in males, and incrementally decreases with increasing income quintile (see Table 40).

Table 39

Type 3 GEE statistics for ADHD: general population matched cohort one or more hospitalizations for any injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	43.79	<.0001
Sex	1	43.66	<.0001
Age Group	5	10.86	0.0543
Income Quintile	4	47.49	<.0001

Table 40

Relative Rates for ADHD: general population matched cohort one or more hospitalizations for any injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.62	(1.44-1.82)	66.64	<0.0001
Sex				
Male	1.85	(1.54-2.22)	44.37	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.53	(2.09-3.06)	91.23	<0.0001
Q2	1.54	(1.27-1.86)	19.52	<0.0001
Q3	1.27	(1.05-1.54)	5.84	0.0157
Q4	1.12	(0.93-1.35)	1.55	0.2131
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more driver injuries than females, see Tables 41 and 42). Accordingly, the relative rate between the ADHD cohort and the general population cohort for one or more hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 42).

Table 41

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more driver of any vehicle analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	1.30	0.2549
Sex	1	15.71	0.0001
Age Group	5	5.13	0.4004
Income Quintile	4	5.44	0.2447

Table 42

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more driver of any vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.26	(0.87-1.82)	1.51	0.2192
Sex				
Male	2.36	(1.41-3.94)	10.77	0.0010
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females, see Tables 43 and 44). Accordingly, the relative rate between the ADHD cohort and the general population cohort for one or more hospitalizations for injury from a motor vehicle is non-significant (see Table 44).

Table 43

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more motor vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	2.71	0.0994
Sex	1	6.43	0.0112
Age Group	5	2.06	0.8405
Income Quintile	4	7.66	0.1047

Table 44

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more motor vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.36	(0.98-1.9)	3.33	0.0680
Sex				
Male	1.58	(1.07-2.34)	5.36	0.0206
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females, see Tables 45 and 46). Accordingly, the relative rate between the ADHD cohort and the general population cohort for one or more hospitalizations for injury from a non-motor vehicle is non-significant (see Table 46).

Table 45

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more other vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	0.15	0.6970
Sex	1	9.90	0.0017
Age Group	5	9.86	0.0792
Income Quintile	4	9.03	0.0604

Table 46

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more other vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.14	(0.61-2.12)	0.16	0.6854
Sex				
Male	2.50	(1.22-5.12)	6.24	0.0125
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from falls were statistically significant, with the exception of age group and income quintile (see Table 47). The rate of one or more hospitalizations for falls in the ADHD cohort is 1.49 times higher than that of the general population (see Table 48). Furthermore, the relative rate of one or more falls is significantly higher in males (see Table 48).

Table 47

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more falls injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	4.51	0.0336
Sex	1	12.88	0.0003
Age Group	5	2.15	0.8286
Income Quintile	4	4.43	0.3505

Table 48

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more falls injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.49	(1.07-2.08)	5.64	0.0175
Sex				
Male	1.84	(1.25-2.71)	9.66	0.0019
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 49). The rate of one or more hospitalizations for poisoning in the ADHD cohort is 2.42 times higher than that of the general population (see Table 50). Furthermore, the relative rate of one or more poisoning is significantly higher in the lowest two income quintiles, as well as the fourth income quintile, as compared to the highest income quintile (see Table 50).

Table 49

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more poisoning injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	6.30	0.0121
Sex	1	0.28	0.5994
Age Group	5	2.55	0.7685
Income Quintile	4	22.30	0.0002

Table 50

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more poisoning injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.42	(1.42-4.15)	10.41	0.0013
Income Quintile				
Q1	12.93	(3.29-50.84)	13.42	0.0002
Q2	5.00	(1.16-21.49)	4.68	0.0304
Q3	2.62	(0.55-12.36)	1.47	0.2247
Q4	4.97	(1.18-20.91)	4.79	0.0286
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from self harm were statistically significant, with the exception of age group (see Table 51). The rate of one or more hospitalizations for injury from self harm in the ADHD cohort is 3.22 times higher than that of the general population (see Table 52). Furthermore, the relative rate of one or more self harm injuries is significantly higher in females than males, and significantly higher in the lowest and third lowest quintiles, as compared to the highest income quintile (see Table 52).

Table 51

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more self harm injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	28.83	<.0001
Sex	1	15.84	0.0001
Age Group	5	4.67	0.4569
Income Quintile	4	23.56	0.0001

Table 52

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more self harm injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	3.22	(2.39-4.34)	58.92	<0.0001
Sex				
Male	0.45	(0.33-0.62)	23.77	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	3.55	(2.09-6.03)	21.98	<0.0001
Q2	1.51	(0.82-2.77)	1.77	0.1830
Q3	1.95	(1.1-3.47)	5.21	0.0225
Q4	1.48	(0.79-2.78)	1.47	0.2257
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from assault were statistically significant (see Table 53). The rate of one or more hospitalizations for injury from assault in the ADHD cohort is 1.59 times higher than that of the general population (see Table 54). Furthermore, the relative rate of one or more assault injuries is significantly higher in males than females, significantly higher in the second youngest age group compared to the oldest age group, and significantly higher in the lowest two quintiles, as compared to the highest income quintile (see Table 54).

Table 53

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more assault injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	11.56	0.0007
Sex	1	57.12	<.0001
Age Group	5	11.85	0.0368
Income Quintile	4	36.65	<.0001

Table 54

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more assault injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.59	(1.26-2)	15.58	0.0001
Sex				
Male	4.16	(2.72-6.36)	43.27	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	1.12	(0.7-1.79)	0.24	0.6268
Age Group 2: 20 - 21	1.87	(1.2-2.91)	7.66	0.0056
Age Group 3: 22 - 23	1.57	(0.98-2.49)	3.55	0.0594
Age Group 4: 24 - 25	1.02	(0.61-1.72)	0.01	0.9364
Age Group 5: 26 - 27	0.90	(0.53-1.53)	0.15	0.7012
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	3.69	(2.46-5.53)	40.06	<0.0001
Q2	1.95	(1.27-3)	9.22	0.0024
Q3	0.99	(0.63-1.55)	0.00	0.9618
Q4	0.96	(0.62-1.5)	0.03	0.8656
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from inanimate force were statistically significant, with the exception of age group (see Table 55). The rate of one or more hospitalizations for injury from inanimate force in the ADHD cohort is 1.45 times higher than that of the general population (see Table 56). Furthermore, the relative rate of one or more inanimate force injuries is significantly higher in males than females, and significantly higher in the lowest two income quintiles, as compared to the highest income quintile (see Table 56).

Table 55

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more inanimate force injury analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	**$\chi 2$**	**p-value**
Case	1	4.39	0.0361
Sex	1	52.96	<.0001
Age Group	5	5.42	0.3671
Income Quintile	4	13.60	0.0087

Table 56

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more inanimate force injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.45	(1.07-1.95)	5.85	0.0156
Sex				
Male	4.62	(2.71-7.89)	31.51	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.28	(1.42-3.66)	11.76	0.0006
Q2	1.74	(1.07-2.82)	5.02	0.0251
Q3	1.16	(0.69-1.94)	0.30	0.5824
Q4	1.38	(0.81-2.35)	1.41	0.2355
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., significantly higher rates in the lowest two income quintiles, as compared to the highest income quintile, see Tables 57 and 58). Accordingly, the relative rate of one or more hospitalizations for injury from over exertion in the ADHD cohort compared to the general population is non-significant (see Table 58).

Table 57

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more over exertion injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	1.17	0.2790
Sex	1	0.95	0.3297
Age Group	5	1.15	0.9498
Income Quintile	4	13.61	0.0086

Table 58

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more over exertion injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.19	(0.88-1.62)	1.32	0.2504
Sex				
Male	1.34	(0.74-2.43)	0.94	0.3329
Female	Ref	---	---	---
Income Quintile				
Q1	4.76	(2.73-8.3)	30.15	<0.0001
Q2	2.20	(1.22-3.94)	6.97	0.0083
Q3	1.14	(0.65-2.02)	0.22	0.6419
Q4	0.79	(0.42-1.48)	0.55	0.4576
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for all other injuries were statistically significant, with the exception of age group and income quintile (see Tables 59 and 60). The rate of one or more hospitalizations for other injuries in the ADHD cohort is 2.15 times higher than that of the general population (see Table 60). Furthermore, the relative rate of one or more other injuries is significantly higher in males than females, and significantly higher in the youngest compared to the highest age group (see Table 60).

Table 59

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for one or more other type of injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	9.44	0.0021
Sex	1	10.80	0.0010
Age Group	5	10.47	0.0630
Income Quintile	4	2.42	0.6590

Table 60

Relative Rates for ADHD: general population matched cohort hospitalizations for one or more other type of injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.15	(1.44-3.21)	13.98	0.0002
Sex				
Male	2.19	(1.23-3.9)	7.11	0.0076
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

In summary, the majority of the outcome variables were significant in these models, in the anticipated directions. There were significant findings for the following variables: depression, anxiety, personality disorders, conduct disorder, substance abuse, income assistance, high school graduation, any injury, injury from falls, injury from poisoning, injury from self harm, injury from assault, injury from inanimate mechanical force, and other injuries. Similar analyses were conducted using count variables for all of the injury types, with results consistent with the binomial variables presented here (Appendix I).

ADHD: Asthma Matched Cohort Analysis:

As can be observed in Table 61, the Type 3 GEE statistics indicated that all model covariates for the depression analysis were statistically significant. The rate of depression in the ADHD cohort is 1.87 times higher than that of the asthma cohort (see Table 62). Furthermore, the rate of depression is significantly higher in females, incrementally increases with age, and is significantly higher in the lowest three income quintiles compared to the highest income quintile (see Table 62).

Table 61

Type 3 GEE statistics for ADHD: asthma matched cohort depression analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	**$\chi 2$**	**p-value**
Case	1	228.30	<.0001
Sex	1	241.30	<.0001
Age Group	5	107.84	<.0001
Income Quintile	4	29.47	<.0001

Table 62

Relative Rates for ADHD: asthma matched cohort depression analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.87	(1.78-1.97)	603.35	<0.0001
Sex				
Male	0.41	(0.39-0.44)	852.81	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.55	(0.5-0.61)	135.59	<0.0001
Age Group 2: 20 - 21	0.62	(0.56-0.7)	67.12	<0.0001
Age Group 3: 22 - 23	0.73	(0.66-0.81)	37.16	<0.0001
Age Group 4: 24 - 25	0.77	(0.7-0.85)	26.46	<0.0001
Age Group 5: 26 - 27	0.89	(0.81-0.99)	4.46	0.0346
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.24	(1.14-1.36)	24.27	<0.0001
Q2	1.13	(1.04-1.23)	8.44	0.0037
Q3	1.15	(1.06-1.25)	10.80	0.0010
Q4	1.03	(0.95-1.13)	0.60	0.4394
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the anxiety analysis were statistically significant (see Table 63). The rate of anxiety in the ADHD cohort is 1.63 times higher than that of the asthma cohort (see Table 64). Furthermore, the relative rate of anxiety is significantly higher in females, incrementally increases with age, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 64).

Table 63

Type 3 GEE statistics for ADHD: asthma matched cohort anxiety analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	126.47	<.0001
Sex	1	184.39	<.0001
Age Group	5	124.10	<.0001
Income Quintile	4	21.55	0.0002

Table 64

Relative Rates for ADHD: asthma matched cohort anxiety analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.63	(1.53-1.75)	211.13	<0.0001
Sex				
Male	0.48	(0.45-0.52)	402.83	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.48	(0.42-0.54)	136.78	<0.0001
Age Group 2: 20 - 21	0.64	(0.56-0.74)	37.99	<0.0001
Age Group 3: 22 - 23	0.74	(0.65-0.84)	23.29	<0.0001
Age Group 4: 24 - 25	0.87	(0.77-0.99)	4.39	0.0361
Age Group 5: 26 - 27	0.98	(0.87-1.1)	0.15	0.7002
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.23	(1.11-1.37)	15.70	0.0001
Q2	0.98	(0.88-1.1)	0.07	0.7863
Q3	1.06	(0.95-1.18)	0.99	0.3191
Q4	1.03	(0.93-1.14)	0.35	0.5566
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

As noted in Table 65, the Type 3 GEE statistics indicated that all model covariates for the personality disorders analysis were statistically significant. The rate of personality disorders in the ADHD cohort is 4.65 times higher than that of the asthma cohort (see Table 66). Furthermore, the relative rate of personality disorders is significantly higher in females and incrementally increases with age, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 66).

Table 65

Type 3 GEE statistics for ADHD: asthma matched cohort personality disorders analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	90.51	<.0001
Sex	1	34.30	<.0001
Age Group	5	18.56	0.0023
Income Quintile	4	14.18	0.0067

Table 66

Relative Rates for ADHD: asthma matched cohort personality disorders analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	4.65	(3.68-5.88)	165.72	<0.0001
Sex				
Male	0.47	(0.38-0.59)	45.62	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.54	(0.39-0.75)	13.14	0.0003
Age Group 2: 20 - 21	0.70	(0.49-1)	3.87	0.0491
Age Group 3: 22 - 23	0.64	(0.44-0.92)	5.72	0.0168
Age Group 4: 24 - 25	0.83	(0.57-1.22)	0.90	0.3421
Age Group 5: 26 - 27	1.05	(0.74-1.51)	0.08	0.7791
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.80	(1.29-2.5)	12.02	0.0005
Q2	1.26	(0.89-1.78)	1.74	0.1868
Q3	1.01	(0.71-1.45)	0.01	0.9355
Q4	1.11	(0.77-1.6)	0.31	0.5802
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the conduct disorder analysis were statistically significant, with the exception of income quintile (see Table 67). The relative rate of conduct disorder in the ADHD cohort is 6.96 times higher than that of the asthma cohort (see Table 68). Furthermore, the relative rate of conduct disorder is significantly higher in females, and incrementally decreases with age (see Table 68).

Table 67

Type 3 GEE statistics for ADHD: asthma matched cohort conduct disorder analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	53.96	<.0001
Sex	1	6.40	0.0114
Age Group	5	66.27	<.0001
Income Quintile	4	2.80	0.5917

Table 68

Relative Rates for ADHD: asthma matched cohort conduct disorder analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	6.96	(5.09-9.52)	146.96	<0.0001
Sex				
Male	0.64	(0.47-0.87)	8.28	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	13.34	(5.14-34.67)	28.29	<0.0001
Age Group 2: 20 - 21	3.69	(1.35-10.07)	6.49	0.0108
Age Group 3: 22 - 23	1.69	(0.57-5.02)	0.89	0.3452
Age Group 4: 24 - 25	1.64	(0.51-5.3)	0.69	0.4078
Age Group 5: 26 - 27	1.04	(0.29-3.7)	0.00	0.9537
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the substance abuse analysis were statistically significant, with the exception of sex (see Table 69). The rate of substance abuse in the ADHD cohort is 1.88 times higher than that of the asthma cohort (see Table 70). Furthermore, the relative rate incrementally increases with age, and incrementally decreases with increasing income quintile (see Table 70).

Table 69

Type 3 GEE statistics for ADHD: asthma matched cohort substance abuse analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	89.67	<.0001
Sex	1	0.00	0.9867
Age Group	5	64.00	<.0001
Income Quintile	4	74.58	<.0001

Table 70

Relative Rates for ADHD: asthma matched cohort substance abuse analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.88	(1.7-2.07)	156.45	<0.0001
Age Group				
Age Group 1: 18 - 19	0.45	(0.37-0.54)	67.26	<0.0001
Age Group 2: 20 - 21	0.58	(0.48-0.7)	31.85	<0.0001
Age Group 3: 22 - 23	0.61	(0.49-0.75)	21.33	<0.0001
Age Group 4: 24 - 25	0.78	(0.65-0.93)	7.76	0.0054
Age Group 5: 26 - 27	0.83	(0.68-1.03)	2.89	0.0892
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	2.15	(1.84-2.51)	91.91	<0.0001
Q2	1.39	(1.18-1.65)	15.08	0.0001
Q3	1.32	(1.11-1.56)	9.98	0.0016
Q4	1.09	(0.92-1.31)	0.99	0.3192
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the income assistance analysis were statistically significant (see Table 71). The rate of income assistance in the ADHD cohort is 2.72 times higher than that of the asthma cohort (see Table 72). Furthermore, the relative rate of income assistance is significantly higher in females, incrementally increases with age, and incrementally decreases with increasing income quintile (see Table 72).

Table 71

Type 3 GEE statistics for ADHD: asthma matched cohort income assistance analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	**$\chi 2$**	**p-value**
Case	1	308.51	<.0001
Sex	1	83.70	<.0001
Age Group	5	111.61	<.0001
Income Quintile	4	254.95	<.0001

Table 72

Relative Rates for ADHD: asthma matched cohort income assistance analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.72	(2.56-2.9)	1004.17	<0.0001
Sex				
Male	0.58	(0.53-0.63)	162.84	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.33	(0.28-0.39)	183.74	<0.0001
Age Group 2: 20 - 21	0.63	(0.54-0.73)	35.94	<0.0001
Age Group 3: 22 - 23	0.68	(0.59-0.79)	25.94	<0.0001
Age Group 4: 24 - 25	0.84	(0.73-0.96)	6.26	0.0124
Age Group 5: 26 - 27	0.94	(0.82-1.08)	0.75	0.3849
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	5.35	(4.78-5.98)	859.89	<0.0001
Q2	3.04	(2.74-3.37)	445.11	<0.0001
Q3	2.30	(2.07-2.55)	248.07	<0.0001
Q4	1.86	(1.67-2.07)	131.50	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the high school graduation analysis were statistically significant (see Table 73). The rate of high school graduation in the ADHD cohort is 0.79 times lower than that of the asthma cohort (see Table 74). Furthermore, the relative rate of high school graduation is significantly higher in females, incrementally decreases with age, and incrementally increases with increasing income quintile (see Table 74).

Table 73

Type 3 GEE statistics for ADHD: asthma matched cohort high school graduation analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	216.65	<.0001
Sex	1	29.60	<.0001
Age Group	5	77.98	<.0001
Income Quintile	4	220.44	<.0001

Table 74

Relative Rates for ADHD: asthma matched cohort high school graduation analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	0.79	(0.77-0.8)	635.34	<0.0001
Sex				
Male	0.93	(0.91-0.96)	31.25	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	2.86	(2.13-3.86)	47.93	<0.0001
Age Group 2: 20 - 21	2.83	(2.1-3.81)	46.81	<0.0001
Age Group 3: 22 - 23	2.81	(2.09-3.78)	46.23	<0.0001
Age Group 4: 24 - 25	2.69	(2-3.62)	42.34	<0.0001
Age Group 5: 26 - 27	2.45	(1.82-3.31)	34.52	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	0.63	(0.61-0.66)	568.03	<0.0001
Q2	0.81	(0.8-0.83)	321.99	<0.0001
Q3	0.89	(0.88-0.91)	133.97	<0.0001
Q4	0.95	(0.93-0.96)	54.28	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the analysis of one or more hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 75). The rate of one or more hospitalizations for any

type of injury in the ADHD cohort is 1.36 times higher than that of the asthma cohort (see Table 76). Furthermore, the relative rate one or more injuries is significantly higher in males, and incrementally decreases with increasing income quintile (see Table 76).

Table 75

Type 3 GEE statistics for ADHD: asthma matched cohort one or more hospitalizations for any injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	19.55	<.0001
Sex	1	45.21	<.0001
Age Group	5	8.43	0.1342
Income Quintile	4	67.08	<.0001

Table 76

Relative Rates for ADHD: asthma matched cohort one or more hospitalizations for any injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.36	(1.2-1.55)	23.57	<0.0001
Sex				
Male	1.85	(1.55-2.22)	44.43	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.65	(2.18-3.22)	96.68	<0.0001
Q2	1.83	(1.49-2.23)	34.57	<0.0001
Q3	1.14	(0.92-1.43)	1.41	0.2354
Q4	1.30	(1.05-1.61)	5.69	0.0170
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more driver injuries than females, see Tables 77 and 78). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 78).

Table 77

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more driver of any vehicle analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.02	0.8769
Sex	1	26.81	<.0001
Age Group	5	6.05	0.3011
Income Quintile	4	4.36	0.3593

Table 78

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more driver of any vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	0.97	(0.64-1.46)	0.02	0.8775
Sex				
Male	3.58	(2.05-6.23)	20.31	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females) and income quintile (i.e., with the lowest income quintile being significantly higher than the highest income quintile, see Tables 79 and 80).

Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from a motor vehicle is non-significant (see Table 80).

Table 79

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more motor vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.28	0.5970
Sex	1	13.24	0.0003
Age Group	5	6.24	0.2837
Income Quintile	4	14.93	0.0048

Table 80

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more motor vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.11	(0.77-1.59)	0.29	0.5894
Sex				
Male	2.00	(1.33-3)	11.12	0.0009
Female	Ref	---	---	---
Income Quintile				
Q1	2.04	(1.22-3.4)	7.44	0.0064
Q2	1.48	(0.85-2.58)	1.94	0.1640
Q3	0.81	(0.43-1.54)	0.42	0.5181
Q4	1.50	(0.89-2.55)	2.32	0.1281
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females) and age group (i.e., with the youngest two age groups being significantly higher than the oldest age group, see Tables 81 and 82). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from a non-motor vehicle is non-significant (see Table 82).

Table 81

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more other vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.01	0.9314
Sex	1	7.86	0.0050
Age Group	5	13.96	0.0158
Income Quintile	4	3.06	0.5477

Table 82

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more other vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	0.97	(0.53-1.79)	0.01	0.9318
Sex				
Male	2.49	(1.23-5.03)	6.43	0.0112
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	7.18	(1-51.49)	3.84	0.0499
Age Group 2: 20 - 21	7.86	(1.04-59.41)	3.99	0.0458
Age Group 3: 22 - 23	5.86	(0.75-46.01)	2.83	0.0924
Age Group 4: 24 - 25	3.27	(0.38-28.1)	1.17	0.2804
Age Group 5: 26 - 27	4.47	(0.55-36.24)	1.97	0.1609
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from falls were statistically significant, with the exception of sex and age group (see Table 83). The rate of one or more hospitalizations for falls in the ADHD cohort is 1.67 times higher than that of the asthma cohort (see Table 84). Furthermore, the relative rate of one or more falls is significantly higher in the lowest two income quintiles compared to the highest income quintile (see Table 84).

Table 83

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more falls injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	6.19	0.0129
Sex	1	3.06	0.0801
Age Group	5	2.97	0.7039
Income Quintile	4	11.66	0.0200

Table 84

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more falls injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.67	(1.16-2.41)	7.52	0.0061
Income Quintile				
Q1	2.03	(1.19-3.47)	6.66	0.0098
Q2	1.98	(1.13-3.45)	5.76	0.0164
Q3	0.97	(0.51-1.83)	0.01	0.9163
Q4	1.24	(0.68-2.28)	0.50	0.4802
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 85). The rate of one or more hospitalizations for poisoning in the ADHD cohort is 2.07 times higher than that of the asthma cohort (see Table 86). Furthermore, the relative rate of one or more poisoning is significantly higher in the lowest and second highest income quintiles, as compared to the highest income quintile (see Table 86).

Table 85

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more poisoning injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	4.42	0.0355
Sex	1	0.00	0.9635
Age Group	5	2.29	0.8077
Income Quintile	4	17.14	0.0018

Table 86

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more poisoning injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.07	(1.15-3.72)	5.89	0.0152
Income Quintile				
Q1	10.39	(2.54-42.59)	10.58	0.0011
Q2	4.20	(0.95-18.57)	3.58	0.0585
Q3	2.68	(0.56-12.77)	1.53	0.2166
Q4	5.05	(1.17-21.76)	4.73	0.0296
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from self harm were statistically significant, with the exception of age group (see Table 87). The rate of one or more hospitalizations for injury from self harm in the ADHD cohort is 2.25 times higher than that of the asthma cohort (see Table 88). Furthermore, the relative rate of one or more self harm injuries is significantly higher in females than males, and significantly higher in the lowest and second highest income quintiles, as compared to the highest income quintile (see Table 88).

Table 87

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more self harm injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	17.67	<.0001
Sex	1	12.10	0.0005
Age Group	5	2.11	0.8339
Income Quintile	4	17.02	0.0019

Table 88

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more self harm injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.25	(1.65-3.08)	25.93	<0.0001
Sex				
Male	0.52	(0.37-0.72)	14.77	0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.83	(1.69-4.75)	15.49	0.0001
Q2	1.47	(0.85-2.54)	1.87	0.1710
Q3	1.25	(0.69-2.27)	0.55	0.4574
Q4	1.89	(1.09-3.28)	5.10	0.0239
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from assault were statistically significant (see Table 89). The rate of one or more hospitalizations for injury from assault in the ADHD cohort is 1.47 times higher than that of the asthma cohort (see Table 90). Furthermore, the relative rate of one or more assault injuries is significantly higher in males than females, significantly higher in the second and third youngest age groups compared to the oldest age group, and significantly higher in the lowest two quintiles, as compared to the highest income quintile (see Table 90).

Table 89

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more assault injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	8.15	0.0043
Sex	1	48.05	<.0001
Age Group	5	11.07	0.0500
Income Quintile	4	43.61	<.0001

Table 90

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more assault injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.47	(1.15-1.86)	9.80	0.0017
Sex				
Male	3.88	(2.58-5.82)	42.70	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	1.30	(0.65-2.57)	0.56	0.4558
Age Group 2: 20 - 21	2.27	(1.19-4.31)	6.26	0.0124
Age Group 3: 22 - 23	2.11	(1.09-4.06)	4.98	0.0257
Age Group 4: 24 - 25	1.61	(0.84-3.12)	2.03	0.1543
Age Group 5: 26 - 27	1.56	(0.76-3.2)	1.50	0.2203
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	5.25	(3.39-8.15)	54.87	<0.0001
Q2	2.72	(1.66-4.46)	15.69	0.0001
Q3	1.14	(0.65-1.98)	0.20	0.6518
Q4	1.41	(0.85-2.34)	1.80	0.1793
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from inanimate force were statistically significant, with the exception of sex (i.e., with males having significantly higher rates than females, see Table 91). Accordingly, the rate of one or more hospitalizations for injury from inanimate force in the ADHD cohort compared to the asthma cohort, is non-significant (see Table 92).

Table 91

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more inanimate force injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.27	0.6063
Sex	1	44.13	<.0001
Age Group	5	5.53	0.3548
Income Quintile	4	4.50	0.3428

Table 92

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more inanimate force injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.09	(0.78-1.52)	0.27	0.6008
Sex				
Male	4.78	(2.79-8.2)	32.34	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., with rates decreasing with increasing income quintile, see Tables 93 and 94). Accordingly, the relative rate of one or more hospitalizations for injury from over exertion in the ADHD cohort compared to the asthma cohort is non-significant (see Table 94).

Table 93

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more over exertion injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	1.18	0.2764
Sex	1	1.99	0.1579
Age Group	5	1.59	0.9028
Income Quintile	4	18.06	0.0012

Table 94

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more over exertion injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.23	(0.87-1.72)	1.37	0.2424
Income Quintile				
Q1	4.49	(2.37-8.48)	21.38	<0.0001
Q2	3.55	(1.87-6.76)	14.91	0.0001
Q3	1.56	(0.82-2.98)	1.83	0.1758
Q4	0.94	(0.45-2)	0.02	0.8812
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for all other injuries were statistically significant, with the exception of sex (i.e., higher in males than females) and age group (i.e., with higher rates in the youngest four age groups compared to the oldest age group, see Tables 95 and 96). Accordingly, the rate of one or more hospitalizations for all other injuries in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 96).

Table 95

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more other type of injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	1.21	0.2721
Sex	1	15.79	0.0001
Age Group	5	24.77	0.0002
Income Quintile	4	3.76	0.4394

Table 96

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more other type of injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.27	(0.84-1.94)	1.28	0.2576
Sex				
Male	2.74	(1.54-4.88)	11.67	0.0006
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	6.35	(1.59-25.34)	6.85	0.0089
Age Group 2: 20 - 21	6.36	(1.59-25.47)	6.84	0.0089
Age Group 3: 22 - 23	7.28	(1.79-29.64)	7.68	0.0056
Age Group 4: 24 - 25	5.69	(1.33-24.29)	5.52	0.0188
Age Group 5: 26 - 27	2.70	(0.58-12.5)	1.61	0.2049
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

In summary, the majority of the outcome variables were significant in these models, in the anticipated directions. There were significant findings for the following variables: depression, anxiety, personality disorders, conduct disorder, substance abuse, income assistance, high school graduation, any injury, injury from falls, injury from poisoning, injury from self harm, and injury from assault. Unlike the ADHD cohort versus general population cohort matched analyses, the injury from inanimate mechanical force and other injury variables were not significant in this analysis. Similar analyses were conducted using count variables for all of the injury types, with results consistent with the binomial variables presented here (see Appendix I). Furthermore, a matched cohort analysis of an ADHD cohort with comorbid cases of asthma removed versus the asthma cohort was conducted on all outcome variables, and the results were generally consistent with the results presented here (see Appendix J). As mentioned previously, Table 97 provides an overview of the relative rates for all outcome variables, across each of the matched cohort analyses.

Table 97

Relative Rates of all outcome variables, across each matched cohort analyses

	ADHD: General Population		ADHD: Asthma		ADHD (asthma cases removed): Asthma	
Outcome Variable	**RR***	**95% CI****	**RR***	**95% CI****	**RR***	**95% CI****
Depression	**6.79**	**(6.33-7.27)**	**1.87**	**(1.78-1.97)**	**1.76**	**(1.65-1.88)**
Anxiety	**6.02**	**(5.53-6.55)**	**1.63**	**(1.53-1.75)**	**1.51**	**(1.39-1.64)**
Personality Disorders	**15.16**	**(11.17-20.58)**	**4.65**	**(3.68-5.88)**	**4.07**	**(3.06-5.41)**
Conduct Disorder	**25.69**	**(17.33-38.1)**	**6.96**	**(5.09-9.52)**	**6.33**	**(4.35-9.19)**
Substance Abuse	**7.81**	**(6.83-8.94)**	**1.88**	**(1.7-2.07)**	**1.75**	**(1.55-1.98)**
Income Assistance	**3.40**	**(3.2-3.63)**	**2.72**	**(2.56-2.9)**	**2.81**	**(2.61-3.02)**
High School Graduation	**0.77**	**(0.76-0.79)**	**0.79**	**(0.77-0.8)**	**0.80**	**(0.78-0.82)**
Any Injury	**1.62**	**(1.44-1.82)**	**1.36**	**(1.2-1.55)**	**1.43**	**(1.24-1.64)**
Any Injury as Driver	1.26	(0.87-1.82)	0.97	(0.64-1.46)	1.09	(0.69-1.73)
Any Motor Vehicle, Traffic Injury	1.36	(0.98-1.9)	1.11	(0.77-1.59)	1.16	(0.74-1.8)
Any Vehicle, Non-Traffic Injury	1.14	(0.61-2.12)	0.97	(0.53-1.79)	1.14	(0.59-2.2)
Any Injury from Falls	**1.49**	**(1.07-2.08)**	**1.67**	**(1.16-2.41)**	**1.75**	**(1.14-2.68)**
Any Injury from Poisoning	**2.42**	**(1.42-4.15)**	**2.07**	**(1.15-3.72)**	**2.39**	**(1.37-4.18)**
Any Injury from Intentional Self Harm	**3.22**	**(2.39-4.34)**	**2.25**	**(1.65-3.08)**	**1.91**	**(1.31-2.79)**
Any Injury from Assault	**1.59**	**(1.26-2)**	**1.47**	**(1.15-1.86)**	**1.57**	**(1.17-2.1)**
Any Injury from Inanimate Mechanical Force	**1.45**	**(1.07-1.95)**	1.09	(0.78-1.52)	1.22	(0.84-1.77)
Any Injury from Over Exertion	1.19	(0.88-1.62)	1.23	(0.87-1.72)	1.39	(0.97-1.99)
Any Other Injuries	**2.15**	**(1.44-3.21)**	1.27	(0.84-1.94)	1.11	(0.65-1.89)
Counts of any Injury	**1.77**	**(1.54-2.03)**	**1.56**	**(1.34-1.81)**	**1.61**	**(1.37-1.89)**
Counts of Injury as Driver	1.23	(0.84-1.8)	1.02	(0.66-1.57)	1.19	(0.73-1.94)
Counts of Motor Vehicle, Traffic Injury	1.41	(0.99-2.01)	1.21	(0.82-1.78)	1.30	(0.81-2.09)
Counts of Any Vehicle, Non-Traffic Injury	1.14	(0.6-2.17)	1.03	(0.54-1.97)	1.26	(0.62-2.54)
Counts of Injury from Falls	**1.58**	**(1.1-2.25)**	**1.75**	**(1.19-2.57)**	**1.97**	**(1.24-3.12)**
Counts of Injury from Poisoning	**2.59**	**(1.49-4.49)**	**2.28**	**(1.24-4.2)**	**2.51**	**(1.45-4.35)**
Counts of Injury from Intentional Self Harm	**4.11**	**(2.81-6.03)**	**2.94**	**(1.94-4.47)**	**2.33**	**(1.54-3.52)**
Counts of Injury from Assault	**1.68**	**(1.3-2.16)**	**1.50**	**(1.16-1.96)**	**1.64**	**(1.19-2.27)**
Counts of Injury from Inanimate Mechanical Force	**1.50**	**(1.09-2.07)**	1.08	(0.75-1.56)	1.25	(0.82-1.89)
Counts of Injury from Over Exertion	1.18	(0.88-1.6)	1.25	(0.88-1.77)	**1.49**	**(1.01-2.19)**
Counts of Other Injuries	**2.05**	**(1.36-3.09)**	1.31	(0.84-2.03)	1.22	(0.69-2.14)

**RR refers to Relative Risk; **CI refers to Confidence Interval; Bolded values are significant at p ≤ .05*
Note: Please see Appendices F, G, and H for crude prevalence and count values for each outcome variable

Discussion

The majority of the study hypotheses were supported in this study and the findings revealed new and important information about the population of young adults (aged 18-29) in Manitoba who have a lifetime diagnosis of ADHD. This discussion will review results from each of the three study sections: (1) examination of crude prevalence, (2) presence of a socioeconomic gradient, and (3) matched cohort analysis of health and social outcomes, according to the hypotheses made and in relation to other research. The discussion will then conclude with a review of study limitations, strengths, considerations for future research and implications.

Research Question 1 – Crude prevalence

The first hypothesis of research question one was that adult ADHD prevalence in Manitoba adults would be ~1.82%, as the National Comorbidity Survey Replication estimated the prevalence of adults aged 18 to 44 in the United States to be 4.4% (Kessler et al., 2006), and previous ADHD research on the Manitoba child population (Yallop, 2008) found prevalence to be about 41% lower than that in the United States (Bloom & Cohen, 2007). While the lifetime prevalence in Manitoba young adults was much higher than this (i.e., 7.11%), the rate of those first diagnosed between ages 14 to 29, which represents a conservative estimate of those who continued to experience clinically significant symptoms in adulthood, was 1.13% (i.e., 2,342 of 207,544). Given that this study was based on a smaller age range (i.e., 18 to 29 versus 18 to 44), it appears that the prevalence from this study is lower, yet somewhat consistent with previous research.

The second hypothesis was that more men than women will have a lifetime diagnosis of ADHD, with an approximate ratio of 2:1 (Kessler et al., 2006). As the lifetime prevalence for males was 10.30% and 3.86% for females, the ratio was 2.67:1 (see Figure 2), which is higher, yet relatively close to the hypothesized ratio. Given that previous research on Manitoba children has found a sex ratio for ADHD diagnosis of 3 or 4 to 1 (Brownell & Yogendran, 2001; Yallop, 2008), it appears that these results follow the same trend of dissipating sex differences with increasing age as other studies investigating adult ADHD (Kessler et al., 2006).

The third hypothesis, that there would be higher prevalence of diagnosis of ADHD for young adults in urban areas compared to those in rural locations, was also confirmed (see Figures 3 and 4). As noted in the results section, the elevated rate in Churchill, Manitoba is likely an artifact of the small population size in this region and the geographical mobility of this age group. Otherwise, the urban areas (i.e., Winnipeg and Brandon) had the highest rates, followed by the regions surrounding urban areas (i.e., Interlake and Assiniboine), and the lowest rates were found in the most rural regions (see Figure 4).

The fourth hypothesis, that there would be no significant differences in prevalence across age groups, was not confirmed. As evidenced in Figure 5, prevalence incrementally decreased with increasing age group, in a gradient pattern. Despite past research that does not support the existence of any significant age trends in adult ADHD (Kessler et al., 2006), these results suggest that perhaps as a function of the overall increase in the diagnosis of ADHD in Manitoba over the years (Brownell & Yogendran, 2001; Martens et al., 2004; Yallop, 2008), lifetime diagnostic rates for young adults in Manitoba in 2008/09 decease with age.

Similarly, prevalence according to age at diagnosis did not entirely follow expected patterns (see Figure 9). While it was hypothesized that ADHD diagnosis prevalence would be highest at ages 10 to 13 years, next highest at 7 to 9 years, then 14 to 29, 4 to 6, and 0 to 3 years (Brownell & Yogendran, 2001; 2005; Martens et al., 2004, Yallop, 2008), the actual prevalence was highest at 7 to 9 years, followed by 10 to 13 years, 4 to 6 years, 14 to 29 years, and 0 to 3 years. Notably, the proportions of diagnoses in the two youngest age groups were relatively high (i.e., 15.87%, or 2,342 of 14,762 young adults with ADHD for ages 0 to 3, and 19.43%, or 2,868 of 14,762 young adults with ADHD for age 4 to 6). Perhaps this is a result of the emergence of the use of diagnostic markers starting as early as infancy (Gurevitz et al., 2012). Additionally, it is interesting to note that ADHD was commonly diagnosed across all age groups (i.e., rates vary from 15.87% to 25.08%) for Manitoba young adults.

The sixth hypothesis stated that adults with lower SES were expected to have higher prevalence of diagnosis compared to those with higher SES and this relationship was predicted to occur in an inverse gradient form (i.e. increasing prevalence of ADHD with decreasing SES). As can be observed in Figure 6, the results revealed a subtle, direct gradient pattern for ADHD diagnosis by SES (i.e., increasing prevalence with increasing SES). This relationship is likely driven by stronger, direct gradient pattern in the rural population (see Figure 8 and Tables 5 & 6). While previous research with child populations have found an inverse socioeconomic gradient pattern (Miller et al., 2001; Brownell and Yogendran, 2001, 2005; Yallop, 2008), it appears that this pattern may dissipate by young adulthood for Manitoba young adults, particularly in urban areas (see Figure 7).

Finally, hypothesis seven stated that prevalence of psychostimulant treatment for Manitoba young adults would be somewhere in the range of .20% to .48%, given that Kessler et al. (2006) found that .48% of adults 18 to 44 were currently receiving treatment for ADHD and Manitoba rates are typically lower than those in the United States. As can be observed in Table 1, the rate for any psychostimulant prescription in adulthood for ADHD was .72%, and the rate for receiving psychostimulant treatment for ADHD in adulthood only was .58%. Therefore, the rates are even higher than anticipated. Furthermore, 10.09% of the ADHD cohort in this study received psychostimulant treatment in adulthood, and 8.14% of the ADHD cohort received psychostimulant treatment exclusively in adulthood (see Table 2). Perhaps these increasing rates correspond with the findings in the literature that not only do psychostimulants facilitate the dopaminergic transmission that is disrupted in adults with ADHD, they specifically improve executive functioning, which is one of the characteristic deficits of ADHD across the life course (Solanto, 2002; Cheon et al., 2003; Volkow et al., 2007; Kollins et al., 2009; Kessler et al., 2010).

In summary, the crude prevalence analysis revealed a relatively high lifetime prevalence of ADHD (7.11%), and a conservatively estimated adult prevalence that generally corresponds with the hypothesized value (1.13%). The lifetime ADHD diagnosis rate ratio by sex (i.e., 2.67: 1, males to females) was close to the expected ratio and the rates by region followed the hypothesized pattern of being higher in urban areas than rural areas. Prevalence decreased with increasing age, possibly due to increasing prevalence with time, and rates according to age at diagnosis were highest in the 7 to 9 age group, and then incrementally decreased towards the youngest and oldest age groups. The socioeconomic gradient pattern did not emerge as expected, as there was a direct gradient relationship in rural areas, no gradient in urban areas, and a slight, direct socioeconomic gradient in the overall rates. Finally, prevalence of psychostimulant treatment was higher than expected (.72%) and taken into adulthood by 10.09% of the ADHD cohort.

Research Question 2 – Socioeconomic gradient analyses

As indicated in the results section, this study found: a slight, direct overall socioeconomic gradient, a significant region of residence* income quintile interaction, and a non-significant age group* income quintile interaction (which was not significantly altered by the use of a three-level vs. a six-level age group variable, or the use of an urban-only vs. total population cohorts). Overall, the best fitting model was: sex, region, age group (six-level), income quintile and a region* income quintile interaction within the total population (see Tables 5 and 6). Additionally, results from the logistic regression testing for an interaction between income quintile and age at diagnosis found that individuals from the very highest income quintile were significantly less likely to be diagnosed before age 18 compared to all other income quintiles (see Tables 23 and 24).

The first hypothesis of this research question stated that there would be a significant inverse socioeconomic gradient for diagnostic rates of ADHD in the overall population of young adults based on prior Manitoba population-based research with the child population (Brownell & Yogendran, 2001; Martens et al., 2004; Yallop, 2008). This was not supported by the results from this study (see Table 3). However, the hypothesized relationship between income quintile and region of residence was confirmed, as there was a significant, direct socioeconomic gradient in young adults living in rural areas (see Tables 5 and 6) and a significant, yet small, inverse socioeconomic gradient in young adults living in urban areas (see Tables 5, 6, 15 and 16). The pattern found in the rural areas (i.e., increasing diagnoses with increasing SES) may be caused in part by the fact that there are fewer medical specialists (e.g., pediatricians, psychiatrists, etc.) in rural areas, thus enabling young adults living in these areas to have reduced access to such specialists and accordingly, to have a lower likelihood of getting diagnosed (Brownell & Yogendran, 2001; Yallop, 2008). Past research has also found that rural health records may have incomplete data from nursing stations and more within-area heterogeneity in SES (Brownell & Yogendran, 2005). Furthermore, a previous study found that there were missing shadow billings from approximately one third of salaried physicians in Manitoba, and that salaried physicians most commonly reside in rural areas (Katz et al., 2009).

These results suggest that a while there were similar socioeconomic gradient patterns within urban and rural populations of Manitoba young adults with a lifetime diagnosis of ADHD, compared to previous research with the Manitoba child population (Brownell & Yogendran, 2001; 2005; Yallop, 2008), the strength of these relationships are much smaller and the overall inverse socioeconomic gradient is no longer evident. These results are consistent with the childhood-limited model of ADHD and SES described by Chen, Boyce, & Mathews (2002), in which inequalities in early life diminish with age. The fact that the socioeconomic gradient for ADHD diagnosis appears to dissipate by young adulthood is encouraging news, particularly given that ADHD is generally considered a neurological disorder that originates from birth (i.e., with genetic and environmental influences on the developing brain being the primary etiological domains), rather than being more predominantly environmental in origin (Nigg, 2006).

In regard to the SES by age interaction, it was hypothesized that the socioeconomic gradient would steepen with increasing age, as previous research linked ADHD with poor educational and occupational outcomes (Bernfort, Nordfelt, & Persson, 2008), and it was thought that this would correspond to a reduction in SES over the course of young adulthood. This hypothesis was not supported by the results from this study, as none of the income quintile * age group interactions were significant (see Tables 7, 8, 13, 14, 17, 18, 21, and 22), regardless of use of a six- versus a three-level age group variable or a total population versus urban only analysis. Subsequently, it does not appear that the socioeconomic gradient for lifetime diagnosis of ADHD in young adults changes with increasing age.

It is possible that this finding was influenced by the fact that prevalence of lifetime ADHD decreased with age (see Figure 5), such that there may have been more unidentified individuals with ADHD in the older age groups. Furthermore, as reported in a publication from Statistics Canada (2012), over 43.3% of young adults aged 20 to 29 from Winnipeg, Manitoba were living with their parents in 2011, which is even higher than the national average. Additionally, rates of 20- to 29-year-olds living with their parents have steadily increased across Canada since 1981 (2012). Subsequently, it is possible that young adulthood (i.e., ages 18 to 29) may be too early to accurately determine the neighborhood income level in which they will eventually reside.

Finally, it was hypothesized that for individuals diagnosed in childhood, higher diagnostic rates of ADHD would be found in adults from lower income areas, whereas no socioeconomic gradient pattern would be found in ADHD diagnostic rates for those diagnosed in adulthood. This was based on the findings from Mannuzza, Klein, Bessler, Malloy, & Hynes (1997), who found that adults who had primary ADHD symptoms in childhood were more likely to have lower-status employment. Results from this study did not find a gradient relationship between income quintile and age at diagnosis during childhood, although individuals from the very highest income quintile were found to be significantly less likely to be diagnosed before age 18 compared to all other income quintiles (see Tables 23 and 24). Since past Canadian research has found that post secondary attendance, and particularly university attendance, is more likely in individuals from higher income families (Rahman, Situ, & Jimmo, 2005), perhaps ADHD diagnosis in young adulthood is more likely in the highest income quintile due to the considerable academic demands required to graduate high school and succeed in college or university. In other words, the elevation in diagnosis rates beyond age 18 for the highest income young adults may correspond with a need to address any barriers to completion of post secondary education.

Another finding from the SES by age at diagnosis analysis was that females were significantly more likely to be diagnosed after age 18 than males (see Table 23). This corresponds with other research that has found that women report higher levels of current ADHD symptoms in adulthood compared to men (Halmoy et al., 2009). Finally, the region of residence covariate was also significant in the model, indicating that those living in urban areas were significantly more likely to be diagnosed after age 18 than those living in rural areas (see Table 23). As mentioned previously, this finding may be partially caused by the greater proportion of medical specialists in urban areas, which then enables young adults living in these areas to have greater access to such specialists and accordingly, to be more likely to be diagnosed regardless of age (Brownell & Yogendran, 2001; Yallop, 2008).

To conclude, it appears that socioeconomic gap for ADHD diagnosis in Manitobans dissipates into young adulthood (Brownell & Yogendran, 2001, Yallop, 2008). However, when region of residence was accounted for, a small inverse gradient in the urban population and a direct gradient in the rural population were observed. Age did not have a significant effect on the socioeconomic gradient. Similarly, age at diagnosis did not interact with SES in a gradient pattern, although individuals from the very highest income quintile were found to be significantly less likely to be diagnosed before age 18 compared to all other income quintiles.

Research Question 3 – Matched cohort outcome analyses

It was hypothesized that the ADHD group would have higher rates of health and social service utilization compared to either comparison group, as outcome studies had found that a majority of individuals with ADHD continue to experience health and social deficits into adulthood (Ingram et al. 1999; Harpin, 2005; Bernfort, Nordfelt, & Persson, 2008). This study investigated several outcomes that were noted as commonly continuing into adulthood: depression, anxiety, conduct disorder, personality disorders, substance abuse, increased rates of injuries, difficulties maintaining employment, and poor educational outcomes (Ingram et al., 1999; Harpin, 2005; Secnik, Swensen, & Lage, 2005; Kessler et al., 2006; Barkley & Brown, 2008; Antshel & Barkley, 2009). Each outcome was investigated using two separate comparison groups, a general population cohort and a chronic condition (asthma) comparison group. An additional asthma analysis with asthma cases removed from the ADHD cohort was conducted to account for any variance that having comorbid ADHD and asthma might have on the findings.

Overall, relative rates for the mental health variables in the ADHD compared to the general population matched cohort analysis tended to be larger than those of the ADHD compared to the asthma matched cohort analyses. This corresponds with a recent study on asthma and mental health disorders in Canada (Goodwin, Pagura, Cox, & Sareen, 2010) that found that not only is asthma associated with a significantly increased risk of several mental health disorders, having asthma and comorbid mental health disorders was associated with significantly elevated levels of daily functional impairment. Furthermore, a report from the Government of Canada (2006) indicated that Canadians with chronic physical conditions had twice the likelihood of also experiencing a mood or anxiety disorder when compared to those without a chronic physical condition. Perhaps this provides some explanation for why the asthma and ADHD cohorts are more similar in regard to the mental health outcomes investigated in the present study. Interestingly, the relative rates for the physical health (i.e., injury) variables were more similar across all matched cohort analyses, with the exception of injury from self harm, which could be classified as an injury variable that is highly associated with mental health concerns. It is also important to note that the overall match rates for the ADHD compared to the asthma analyses were less strong than those from the ADHD compared to the general population analysis (see Appendix E), so this may also have contributed to the differences in rates between these two analyses (i.e., with the ADHD compared to the asthma analysis having lower numbers due to reduced match rates). Since the outcome variables that were significant corresponded closely across analyses using both general population and asthma comparison groups, this is reflective of strong concurrent validity between these results, which further strengthens the overall validity of the relationships between lifetime ADHD and the significant outcome variables. The following discussion will review each set of analyses one outcome at a time.

Depression

The relative rates of depression were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of depression compared to the general population and another chronic condition cohort. Consistent with typical diagnostic patterns, females were more likely than males to have depression and the rates of depression incrementally increased into young adulthood (American Psychiatric Association, 2000). Interestingly, while income quintile was not significant in the ADHD compared to the general population analysis, it was significant in the ADHD compared to the asthma analyses, suggesting that for those with multiple chronic conditions, depression is linked to SES.

Anxiety

The relative rates of anxiety were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher prevalence of anxiety compared to the general population and another chronic condition cohort. Consistent with typical diagnostic patterns, females were more likely than males to have anxiety and the rates of anxiety incrementally increased into young adulthood (American Psychiatric Association, 2000). Similar to the depression analysis, income quintile was not significant in the ADHD compared to the general population analysis, yet it was significant in the ADHD compared to asthma analyses. Again, this indicates that for those with multiple chronic conditions, anxiety is linked to SES.

Personality Disorders

The relative rates of personality disorders were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of personality disorders compared to the general population and another chronic condition cohort. Furthermore, the relative rates were quite high (i.e., 15.16, 4.65, and 4.07, in order of the matched analyses listed in Table 97), indicating that young adults with lifetime ADHD are much more likely to have a comorbid personality disorder diagnosis compared to the general population. Consistent with typical diagnostic patterns, females were more likely than males to have personality disorders and the rates of personality disorders incrementally increased into young adulthood (American Psychiatric Association, 2000). Furthermore, the rates of personality disorders were significantly higher in the lowest income quintile compared to the highest income quintile, which is consistent with previous research (Torgersen, Kringlen, & Cramer, 2001).

Conduct Disorder

The relative rates of conduct disorder were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of conduct disorder compared to the general population and another chronic condition cohort. Furthermore, the relative rates were quite high (i.e., 25.69, 6.96, and 6.33, in order of the matched analyses listed in Table 97), indicating that this is a particularly close association between lifetime ADHD and conduct disorder in young adults. While the finding that rates of conduct disorder incrementally decreased into young adulthood is consistent with typical diagnostic patterns, the finding that females were more likely than males to have conduct disorder is in opposition to the typical patterns found (i.e., with conduct disorder generally being more commonly diagnosed in males than females; American Psychiatric Association, 2000). However, since this study uses a five year capture period for the outcome variables (2004/05 to 2008/09) and an age range of 18 to 29 years, the rates from this study represent those diagnosed in late adolescence and early adulthood. Additionally, current research indicates that the sex disparity in conduct disorder diagnoses tends to dissipate by late adolescence (Meier, Slutske, Heath, & Martin, 2011; Moffitt, 2003), which provides some support for this finding. Socioeconomic status was not significant in any of the models, indicating that conduct disorder is diagnosed relatively evenly across all income quintiles in young adults.

Substance Abuse

The relative rates of substance abuse were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of substance abuse compared to the general population and another chronic condition cohort. While the finding that rates of substance abuse incrementally increased into young adulthood is consistent with typical diagnostic patterns (American Psychiatric Association, 2000; Wilens, 2011), the finding of no significant sex differences in rates of substance abuse is somewhat less typical. However, some research suggests that the commonly reported sex disparity in substance abuse (i.e., that men have higher rates) has decreased over the years, such that while some sex-related differences (e.g., age at onset, social influences, and treatment access patterns) have persisted, the overall rates of substance abuse are similar between men and women (Brady & Randall, 1999). Furthermore, socioeconomic status was significant in all models, which is generally consistent with previous research (Reinherz, Giaconia, Hauf, Wasserman, & Paradis, 2000).

Income Assistance

The relative rates of income assistance were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of receiving income assistance compared to the general population and another chronic condition cohort. Additionally, rates were higher in females than males, incrementally increased with age, and incrementally increased with decreasing income. These findings are consistent with previous Manitoba research investigating income assistance in mental health conditions according to sex, age, and income quintile (Mustard, Derksen, & Kozyrskyj, 2000). Another report from Manitoba showed that for older teens (18-19), a large portion of income assistance cases were found in single parent families, as many of these cases were due to young single mothers (Brownell, De Coster, Penfold, Derksen, Au, Schultz, & Dahl, 2008). This is also consistent with the finding of higher rates of income assistance in females compared to males in the present study.

High School Graduation

The relative rates for high school graduation were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly lower rate of graduating high school compared to the general population and another chronic condition cohort. Additionally, high school graduation rates were higher in females than males, incrementally decreased with age, and incrementally increased with increasing income. These findings are consistent with previous Manitoba research investigating high school graduation rates according to sex, age, and income quintile (Brownell et al., 2004; 2012). Notably, Brownell et al.'s (2012) recent longitudinal study found that high school graduation rates in Manitoba increased by approximately seven percent between 2002/03 and 2009/10, which corresponds with the finding of decreasing rates with increasing age in the present study.

Any Injury

The relative rates for hospitalization for any type of injury were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries compared to the general population and another chronic condition cohort. As found in previous injury hospitalization research in Manitoba children (Brownell, Derksen, Jutte, Roos, Ekuma, & Yallop, 2010), injury rates were higher in males and decreased with increasing income quintile.

Vehicle Injuries

There were three variables that represented types of vehicle injuries: injury from being the driver of any type of vehicle, injury from a traffic accident with a motor vehicle, and injury from a non-traffic accident with any type of vehicle. The relative rates were not significant for any of these variables (see Table 97). Given that past research has quite consistently found a significant correlation between ADHD and motor vehicle collisions (Barkley, Murphy, & Kwasnik, 1996; Barkley, Murphy, & Fischer, 2008; Fried et al., 2006), these findings were not in support of the study hypotheses. However, crude rates for each of these variables were particularly low (see Tables 9-11 in Appendices F, G, and H), and the general trends of these crude rates were in the direction of more vehicle injuries in the ADHD cohort compared to the control groups, so there is some possibility that these findings may be an artifact of the low count values for these relatively rare events. Furthermore, only those traffic injuries serious enough to warrant hospitalization were included in these analyses. Young adults treated in emergency rooms without being admitted, or those treated as outpatients were not captured in this analysis, which may also have contributed to the lack of association found in these results.

Injury from Falls

The relative rates for hospitalization for injury from falls were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries from falls compared to the general population and another chronic condition cohort. Interestingly, in the ADHD compared to general population analysis, sex was the only other significant covariate (i.e., with higher rates in males), whereas in the ADHD compared to asthma analyses, SES was the only other significant covariate (i.e., with higher rates in the lowest two income quintiles compared to the highest income quintile).

Injury from Poisoning

The relative rates for hospitalization for injury from poisoning were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries from poisoning compared to the general population and another chronic condition cohort. These findings are consistent with past research on children that found that injury from poisoning was among the categories of injuries most strongly associated with ADHD (Merrill, Lyon, Baker, & Gren, 2009). SES was another significant covariate across all analyses, with significantly higher rates in the lowest two and second highest income quintiles compared to the highest income quintile in the ADHD compared to general population analysis, and significantly higher rates in the lowest and second highest income quintiles compared to the highest income quintile in the ADHD compared to asthma analyses.

Injury from Intentional Self Harm

Consistent with previous research (James, Lai, & Dahl, 2004; Manor et al., 2010), the relative rates for hospitalization for injury from intentional self harm were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries from intentional self harm compared to the general population and another chronic condition cohort. Other significant covariates included sex (i.e., rates were significantly higher in females), and SES (i.e., there were significantly higher rates in the lowest and third lowest income quintiles compared to the highest income quintile in the ADHD compared to general population analysis, and significantly higher rates in the lowest and second highest income quintiles compared to the highest income quintile in the ADHD compared to asthma analyses). These results are interesting to consider in the context of a study by Garcia et al. (2012), as they found that severity of ADHD symptoms, lower SES status, female gender, and the presence of comorbid mood disorders significantly corresponded with negative life events (i.e., death or illness in a loved one, serious injury, adverse changes in work status, other types of significant loss, etc.). Given that current research also posits that adverse life events are proximal to adult suicide (Foster, 2011), targeted self harm prevention interventions for young adults with symptomatic ADHD, and particularly for female, low SES, young adults with comorbid ADHD and mood disorders, may aid in reducing these disparities in self harm rates.

Injury from Assault

The relative rates for hospitalization for injury from assault were significant across all matched cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries from assault compared to the general population and another chronic condition cohort. These findings are consistent with past research on ADHD within forensic populations, which have found that lifetime diagnosis of ADHD is significantly correlated with risk for reactive violence and aggressive behavior (Retz & Rosler, 2010; Young & Thome, 2011). Additional covariates significant across all models were sex (i.e., higher rates in males), age (i.e., higher rates in the youngest two age groups compared to the oldest age group in the ADHD compared to general population analysis and higher rates in the second and third youngest age groups compared to the oldest age group in the ADHD compared to asthma analysis), and SES (i.e., significantly higher rates in the lowest two income quintiles compared to the highest income quintile).

Injury from Inanimate Mechanical Force

Injuries from inanimate mechanical force included the following: struck by thrown, projected, falling or stationary object, caught, crushed, jammed, or pinched in or between objects, contact with lifting and transmission devices, contact with sharp glass, contact with knife, sword, or dagger, contact with tools and machinery, firearm discharge, explosion, foreign object entering the body, hypodermic needle contact, or unspecified inanimate mechanical forces. The relative rates for injury from inanimate mechanical force were significant in the ADHD compared to general population analysis, but not in the ADHD compared to asthma cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of injuries from inanimate mechanical force compared to the general population, but not compared to a chronic condition cohort. For the ADHD compared to general population analyses, rates were higher in males, and higher in the lowest two income quintiles compared to the highest income quintile. While research on specific types of injuries in the adult ADHD population is limited, the ADHD compared to general population analysis results were in accordance with what was expected based on the existing literature on ADHD and injuries (Kaya et al., 2008; Brownell, Derksen, Jutte, Roos, Ekuma, & Yallop, 2010). In regard to the ADHD compared to asthma results, it is possible that having another chronic condition such as asthma further elevates one's likelihood of sustaining injury from inanimate mechanical force. However, since the ADHD compared to asthma analyses crude rate trends for inanimate mechanical force were in the expected direction (see Tables 16 and 27 in Appendices G, and H), it is also possible that these findings are an artifact of the low count values for these relatively rare events.

Injury from Overexertion, Travel, and Privation

Injuries from overexertion included the following: overexertion and strenuous or repetitive movements, travel and motion, prolonged stay in weightless environment, lack of food or water, or unspecified privation. The relative rates for injury from overexertion were not significant in any of the analyses, with the exception of the injury count analysis for the ADHD (asthma cases removed) compared to asthma cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD may have a significantly higher rate of injury counts from overexertion compared to a chronic condition cohort, but not compared to the general population. These findings are somewhat difficult to interpret, as they may be more reflective of the low count values for these relatively rare events, particularly in light of the crude rate trends for overexertion being in the expected direction (see Tables 17 and 28 in Appendices F, G, and H).

Other Injuries

Other injuries were defined as: exposure to smoke, fire, and flames, contact with heat and hot substances including burns, contact with venomous animals and plants, exposure to forces of nature, accidental drowning, accidental strangulation, accidental sports injury, sequelae/ late effects of previous injuries, exposure to animate mechanical forces including animal bites and injuries, exposure to electric current, and legal intervention and operations of war. The relative rates for other injuries were significant in the ADHD compared to general population analysis, but not in the ADHD compared to asthma cohort analyses (see Table 97), indicating that young adults with a lifetime diagnosis of ADHD have a significantly higher rate of other types of injuries compared to the general population, but not compared to a chronic condition cohort. Again, research on specific types of injuries in the adult ADHD population is limited, yet the ADHD compared to general population analysis results were in accordance with what was expected based on the existing literature on ADHD and injuries (Kaya et al., 2008; Brownell, Derksen, Jutte, Roos, Ekuma, & Yallop, 2010). In regard to the ADHD compared to asthma results, it is possible that having another chronic condition such as asthma further elevates one's likelihood of sustaining other injuries. However, since the ADHD compared to asthma analyses crude rate trends for other injuries were in the expected direction (see Tables 18 and 29 in Appendices G and H), it is also possible that these findings are an artifact of the low count values for these relatively rare events.

Overall, the matched cohort analyses provide strong support for the prediction that a lifetime diagnosis of ADHD is significantly correlated with adverse mental health, physical health, educational, and occupational deficits into young adulthood. The following outcome variables were significant across all matched cohort analyses: depression, anxiety, personality disorders, conduct disorder, substance abuse, income assistance, high school graduation, any injury, injury from falls, injury from poisoning, injury from self harm, and injury from assault. Furthermore, injuries from inanimate mechanical force and other injuries were significant in the ADHD compared to general population analysis and counts of injury from overexertion was significant in the ADHD (with asthma cases removed) compared to asthma analysis. As previously discussed, sex, age, and SES were significant covariates in many of these outcome variable models, which further supports use of Andersen's (2008) behavioral model of health services use as the conceptual framework for this study. Furthermore, with SES significantly correlated to several of the outcome variables (in gradient patterns and otherwise), it may be that while the socioeconomic gradient for ADHD diagnosis dissipates into young adulthood, socioeconomic disparities persist in this population through the secondary health and social outcomes, which could potentially have an even greater negative impact on their overall level of functioning.

Strengths

The design of this study is supported by a number of strong points. One of the biggest strengths is the study population size (n = 207,544), which essentially includes the entire population of Manitoban young adults (ages 18 to 29) who were residents of Manitoba during the study period (2007/08 to 2008/09), including all of those with provincial records that indicate ADHD diagnosis or treatment at some point during their lives. Furthermore, having linkage between the multiple databases (i.e. hospital, physician claims, pharmaceutical DPIN claims, public access Census files, social assistance files, education files, and the population registry data) that were used for this study is a real asset because it provides information on all of the variables of interest. The use of previously validated methods for measuring ADHD diagnosis and treatment rates and measures for most of the variables aids in strengthening the results of this study

(Brownell & Yogendran, 2001; 2005; Martens et al. 2004; Yallop, 2008; Doupe et al., 2008; Fransoo et al., 2009; Brownell, Derksen, Jutte, Roos, Ekuma, & Yallop, 2010). As discussed by Jutte, Roos, & Brownell (2011), additional benefits to the use of linked administrative data include: reduced reliance on self-report, the possibility of comprehensive follow up as well as flexibility in defining the study period due to the ongoing collection of data, relatively low expense for conducting research because the information is already collected for other purposes, and the inclusion of under-represented racial/ ethnic and socioeconomic groups.

In addition, the exploration of a wide range of secondary conditions (i.e., depression, anxiety, conduct disorder, personality disorders, substance abuse, injuries, and poor educational and occupational outcomes) is a significant strength of the study because they provided a much fuller picture of adult ADHD in Manitoba, with information about which comorbid conditions are occurring most frequently. This is important because past research demonstrates that most people with ADHD have at least one other comorbid condition (Ingram, Hechtman, & Morgenstern, 1999; The MTA Cooperative Group, 1999; Sobanski, 2006; Barkley & Brown, 2008; Bernfort, Nordfelt, & Persson, 2008). Finally, investigating a previously unexplored population with this dataset adds strength to this study, as it offers a wealth of new information on ADHD in Manitoba young adults.

Limitations

While this study has a number of strong points, some potential limitations should be considered. First, the use of ICD categories within the context of administrative data for determining some of the secondary conditions has not been validated, so only face validity and comparisons to known rates of these comorbidities may be used to verify these measures. Another limitation is the correlational design, which does not allow for any inferences of causality, although still provides important relational information about the variables to be studied. Since pharmaceutical data from the DPIN network are not available until 1995/96, there may be some psychostimulant prescriptions for the ADHD cohort that are not captured, particularly for the oldest individuals. However, the use of 24 fiscal years of data to capture diagnostic codes and 14 years of data to capture treatment codes should reduce the impact of this limitation. In addition, there is some possibility that some young adults who were diagnosed with ADHD as children were not consistently captured in the databases used in this study due to data representation concerns (e.g., particular northern communities that use nursing stations instead of hospitals or health offices with physicians, or those diagnosed by psychologists). Also, this study only captures prevalence of those diagnosed and/or treated with ADHD, rather than prevalence of all diagnosed and undiagnosed individuals. However, much of the rural health data is captured in these datasets and administrative data offer the unique opportunity to observe the rates of diagnosis and treatment that are occurring, which is still interesting and highly worthwhile information.

Some additional limitations to using administrative data, as discussed by Jutte, Roos, & Brownell (2011), include lack of individual-level measures of socioeconomic status, social supports, and interpersonal relationships. It is possible that an individual-level measure would have provided greater accuracy in measuring SES in the present study, although previous research has shown that small-area data from the Census are highly correlated with individual-level SES information (Mustard, Derksen, Berthelot, Wolfson, 1999). Furthermore, some researchers suggest that asset-based measures of SES, such as income, may be more sensitive to detecting gradients over time because they are more prone to fluctuate (Chen, Martin, & Matthews, 2006).

In each of the matched cohort analyses for high school graduation, the education data used to determine this variable were not available for approximately twenty percent of the ADHD cohort and had to be removed from this specific analysis. The missing data included: students who skipped grade nine, students who dropped out of school before grade nine, some students who enrolled in a First Nations school, some students who were home schooled, and youth who moved in or out of the province within the study period, such that their education records were incomplete. However, the relative rate findings were consistent across all matched cohort analyses, which reflects convergent validity. Finally, as a result of recording practices within the physician files that only include the first 3 digits of ICD-9-CM codes, the codes captured for depression and anxiety include a couple extraneous diagnoses (e.g., bipolar disorder and post traumatic stress disorder), which reduces the clarity of the variable.

Future Research

The findings from this study provide a wealth of support for further research into this population. First, in light of the relatively high rates of psychostimulant use in the adult ADHD population as well as the multiple significant health and social outcome variables, it would be helpful to investigate the relationship between psychostimulant use (e.g., age at first treatment, continuity of treatment, etc.) and health and social service use outcomes. This type of analysis could provide a greater understanding of the role that treatment has on secondary outcomes. Second, the finding that young adults with a lifetime diagnosis of ADHD have a significantly lower rate of graduating high school compared to the general population and a chronic condition cohort, along with the forthcoming potential for linking Manitoba post-secondary data to the Manitoba Population Health Research Data Repository, provides a solid basis for further exploration of educational outcomes in young adults with ADHD past high school.

Third, given the relatively low rates of hospitalizations for injuries, it would be helpful to investigate categories of physician visits for various types of injuries, as well as any other available data on motor vehicle injuries, such as car accident reports from the provincial auto insurance agency. Fourth, given that this research used relatively broad definitions for some of the mental health outcomes (e.g., depression, anxiety, personality disorders, and substance abuse) and these variables were significantly related to lifetime ADHD diagnosis, a study that offered a finer look at specific diagnoses in relation to ADHD would allow for even more effective intervention targeting. For example, Miller, Flory, Miller, Harty, Newcorn, & Halperin (2008) found that the risk for the development of personality disorders in a clinical sample of older adolescents and young adults diagnosed with childhood ADHD was not uniform across all personality disorders.

Fifth, as the present study was cross-sectional in nature, a longitudinal analysis of ADHD diagnosis and secondary outcomes could help elucidate more information on the temporal relationship between ADHD diagnosis, treatment, secondary outcomes, and potentially related covariates such as SES. For example, one study on a control-matched clinical sample of young adults with childhood ADHD diagnosis found that SES and comorbid conditions (e.g., substance use and cognitive functioning) significantly differentiated between those who completed high school versus those who dropped out, irrespective of ADHD diagnosis (Trampush, Miller, Newcorn & Halperin, 2009). Accordingly, a population-based investigation of the relationships between ADHD, SES, comorbid diagnoses, and additional secondary outcomes could shed further light on which combinations of conditions that are comorbid with ADHD are associated with other types of health and social outcomes, and whether socioeconomic disparities/ gradients exist for each of these secondary outcomes.

Implications

In conclusion, this study contributes to the literature on ADHD in terms of prevalence for diagnoses and treatment for young adults in Manitoba, a population that had not been previously investigated. It also provides further information regarding the manner in which the socioeconomic gradient for lifetime ADHD diagnosis persists into young adulthood and factors that impact socioeconomic disparities in diagnosis (i.e., region of residence and age at diagnosis). Finally, it provides much needed information on lifetime ADHD diagnosis and several mental health, physical health, educational and occupational outcomes. Such knowledge is important because adult ADHD research has been given relatively little attention within Canada, yet is ultimately necessary for the development of policies and practices that will enhance the health status of all Canadian adults living with ADHD. Furthermore, understanding variables that put people with ADHD at greater risk for lesser health and social outcomes across the lifespan is critical for informing where such policies and services should be targeted.

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Appendix A

List of the *International Classification of Diseases*, *Ninth Edition, Clinical Modification* (ICD-9-CM) and the *International Classification of Diseases, Tenth Edition, with Canadian Enhancements* (ICD-10-CA) codes and definitions used in this study

ADHD

Physician Files:

ICD-9-CM: 314 (hyperkinetic syndrome of childhood)

Hospital Abstracts:

ICD-9-CM: 314 (hyperkinetic syndrome of childhood)
ICD-10-CA: F90 (hyperkinetic disorders)

Definition:

One or more diagnostic code and/or two or more prescriptions for a psychostimulant during 24 fiscal years (1984/85 to 2008/09) and no diagnosis for Conduct disorder, Narcolepsy or Catalepsy.

Asthma

Physician Files:

ICD-9-CM: 493 (asthma)

Hospital Abstracts:

ICD-9-CM: 493 (asthma)
ICD-10-CA: J45 (asthma)

Definition:

One or more diagnostic code and/or one or more prescriptions for an asthma medication during 24 fiscal years (1984/85 to 2008/09).

Depression

Physician Files:

ICD-9-CM: 296 (episodic mood disorders), 309 (adjustment reaction), 311 (depressive disorder, not elsewhere classified)

Hospital Abstracts:

ICD-10-CA: F32 (depressive episode), F33 (recurrent depressive disorder), F34 (persistent mood disorders), F38 (other mood disorders), F43.2 (adjustment disorders), F43.8 (other reactions to severe stress), F53.0 (mental and behavioral disorders associated with the puerperium, not elsewhere classified)

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Anxiety

Physician Files:

ICD-9-CM: 300 (anxiety states)

Hospital Abstracts:

ICD-10-CA: F40 (phobic anxiety disorders), F41 (other anxiety disorders), F42 (obsessive compulsive disorder)

Definition:

One or more diagnostic code in the hospital abstract data and two or more diagnostic codes in the physician files during 5 fiscal years (2004/05 to 2008/09).

Personality Disorders

Physician Files:

ICD-9-CM: 301 (personality disorders)

Hospital Abstracts:

ICD-10-CA: F60 (specific personality disorders), F61 (mixed and other personality disorders)

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Conduct Disorder

Physician Files:

ICD-9-CM:312 (disturbance of conduct, not elsewhere classified), 313 (disturbance of emotions specific to childhood and adolescence)

Hospital Abstracts:

ICD-10-CA: F91 (conduct disorders), F92 (mixed disorders of conduct and emotions)

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Substance Abuse

Physician Files:

ICD-9-CM: 291 (alcohol-induced mental disorders), 292 (drug-induced mental disorders), 303 (alcohol dependence syndrome), 304 (drug dependence), 305 (nondependent abuse of drugs)

Hospital Abstracts:

ICD-10-CA: F10-F19 (mental and behavioral disorders due to psychoactive substance use), F55 (abuse of non-dependence-producing substances)

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injury Variables:

Any Injuries

Hospital Abstracts:

ICD-10-CA: V, X, W, and Y codes (external causes of morbidity and mortality), to be categorized according to: motor vehicle, other vehicle, poisoning, falls, fires and flames, natural and environmental factors, drowning, suffocation and choking, sports, late effects, violence to self, violence by others, other, undetermined

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries incurred as the driver of any vehicle

Hospital Abstracts:

ICD-10-CA: V100, V104, V110, V114, V120, V124, V130, V134, V140, V144, V150, V154, V160, V164, V170, V174, V180, V184, V190, V194, V200, V204, V210, V214, V220, V224, V230, V234, V240, V244, V250, V254, V260, V264, V270, V274, V280, V284, V290, V294, V300, V305, V310, V315, V320, V325, V330, V335, V340, V345, V350, V355, V360, V365, V370, V375, V380, V385, V390, V395, V400, V405, V410, V415, V420, V425, V430, V435, V440, V445, V450, V455, V460, V465, V470, V475, V480, V485, V490, V495, V500, V505, V510, V515, V520, V525, V530, V535, V540, V545, V550, V555, V560, V565, V570, V575, V580, V585, V590, V595, V600, V605, V610, V615, V620, V625, V630, V635, V640, V645, V650, V655, V660, V665, V670, V675, V680, V685, V690, V695, V700, V705, V710, V715, V720, V725, V730, V735, V740, V745, V750, V755, V760, V765, V770, V775, V780, V785, V790, V795, V800, V805, V810, V815, V820, V825, V830, V835, V840, V845, V850, V855, V860, V865

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from motor vehicle traffic accidents

Hospital Abstracts:

ICD-10-CA: V02 – V0499, V09, V12 – V1499, V19 – V1999, V20 – V2999, V30 – V3999, V40 – V4999, V50 – V5999, V60 – V6999, V70 – V7999, V803 – V805, V810, V811, V820, V821, V829, V830 – V833, V840 – V843, V850 – V853, V860 – V863, V87, V88, V890, V892

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from non-traffic, any vehicle accidents

Hospital Abstracts:

ICD-10-CA: V01, V05, V06, V10, V11, V15 – V1899, V800 – V802, V806 – V8099, V812 – V8199, V822 – V828, V834 – V8399, V844 – V8499, V854 – V8599, V864 – V8699, V891, V893, V899, V90 – V9199, V93 – V9999

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from falls

Hospital Abstracts:

W00 – W1999

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from poisoning

Hospital Abstracts:

X40 – X4999, Y10 – Y1999, Y90, Y91

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from intentional self harm

Hospital Abstracts:

X60 – X8499, Y870, Y20 – Y3499

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from assault

Hospital Abstracts:

X85 – X9999, Y00 – Y0999, Y871, Y356

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Injuries from inanimate mechanical force

Hospital Abstracts:

W20, W22 – W4999

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).
\

Injuries from overexertion, travel, and privation

Hospital Abstracts:

X50 – X5999

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Other Injuries

Hospital Abstracts:

X00 – X0999, X20 – X3999, V92, W65 – W7499, W75 – W8499, W21, Y85 – Y8699, Y872, W50 – W64999, W85 – W9999, X10 – X1999, Y350 – Y355, Y357 – Y3999, Y88 – Y8999, Y92 – Y9899

Definition:

One or more diagnostic code during 5 fiscal years (2004/05 to 2008/09).

Appendix B

Psychostimulant and asthma drug codes used in data analysis

Table 1

List of the psychostimulant codes used from the Drug Programs Information Network (DPIN) database

Generic Product Name	Drug Identification Number (DIN)
AMPHETAMINE ASPARTATE	2248808
AMPHETAMINE ASPARTATE	2248809
AMPHETAMINE ASPARTATE	2248810
AMPHETAMINE ASPARTATE	2248811
AMPHETAMINE ASPARTATE	2248812
AMPHETAMINE ASPARTATE	2248813
ATOMOXETINE HYDROCHLORIDE	2262827
ATOMOXETINE HYDROCHLORIDE	2262835
ATOMOXETINE HYDROCHLORIDE	2262843
DEXTROAMPHETAMINE SULFATE	181447
DEXTROAMPHETAMINE 5MG TAB	1924516
DEXTROAMPHETAMINE SULFATE	1924559
DEXTROAMPHETAMINE SULFATE	1924567
METHYLPHENIDATE HCL	5606
METHYLPHENIDATE HCL	5614
METHYLPHENIDATE HCL	422975
METHYLPHENIDATE HCL 10MG TAB	584991
METHYLPHENIDATE HCL 20MG TAB	585009
METHYLPHENIDATE HCL	632775
METHYLPHENIDATE HCL	2230321
METHYLPHENIDATE HCL	2230322
METHYLPHENIDATE HCL	2234749
METHYLPHENIDATE HCL	2247364
METHYLPHENIDATE HCL	2247732
METHYLPHENIDATE HCL	2247733
METHYLPHENIDATE HCL	2247734
METHYLPHENIDATE HCL	2249324
METHYLPHENIDATE HCL	2249332
METHYLPHENIDATE HYDROCHLORIDE	2250241
MODAFINIL	2239665
PEMOLINE	397512
PEMOLINE	397520

Table 2.

List of the asthma medication codes to be used from the Anatomical Therapeutic Chemical (ATC) Drug Classification System

	Generic Product Name	**ATC**
R03A ADRENERGICS, INHALANTS	EPINEPHRINE	R03AA01
	ISOPROTERENOL	R03AB02
	ORCIPRENALINE	R03AB03
	SALBUTAMOL	R03AC02
	TERBUTALINE	R03AC03
	FENOTEROL	R03AC04
	PIRBUTEROL	R03AC08
	SALMETEROL	R03AC12
	FORMOTEROL	R03AC13
	EPINEPHRINE	R03AK01
	IPRATROPIUM/FENOTEROL	R03AK03
	IPRATROPIUM/SALBUTAMOL	R03AK04
	FLUTICASONE/SALMETEROL	R03AK06
R03B OTHER DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES, INHALANTS	BECLOMETHASONE	R03BA01
	BUDESONIDE	R03BA02
	FLUNISOLIDE	R03BA03
	FLUTICASONE	R03BA05
	TRIAMCINOLONE	R03BA06
	IPRATROPIUM	R03BB01
	SODIUM CROMOGLYCATE	R03BC01
	NEDOCROMIL	R03BC03
R03C ADRENERGICS FOR SYSTEMIC USE	ISOPROTERENOL	R03CB01
	ORCIPRENALINE	R03CB03
	SALBUTAMOL	R03CC02
	TERBUTALINE	R03CC03
	PIRBUTEROL	R03CC07
	TERBUTALINE	R03CC53
	BUDESONIDE/FORMOTEROL	R03CK

R03D OTHER SYSTEMIC DRUGS FOR OBSTRUCTIVE AIRWAY DISEASES	OXTRIPHYLLINE	R03DA02
	THEOPHYLLINE	R03DA04
	AMINOPHYLLINE	R03DA05
	THEOPHYLLINE	R03DA43
	THEOPHYLLINE	R03DA53
	THEOPHYLLINE	R03DA54
	AMINOPHYLLINE	R03DA55
	THEOPHYLLINE	R03DA74
	AMINOPHYLLINE	R03DB05
	ZAFIRLUKAST	R03DC01
	MONTELUKAST	R03DC03
R06A ANTIHISTAMINES FOR SYSTEMIC USE	KETOTIFEN	R06AX17

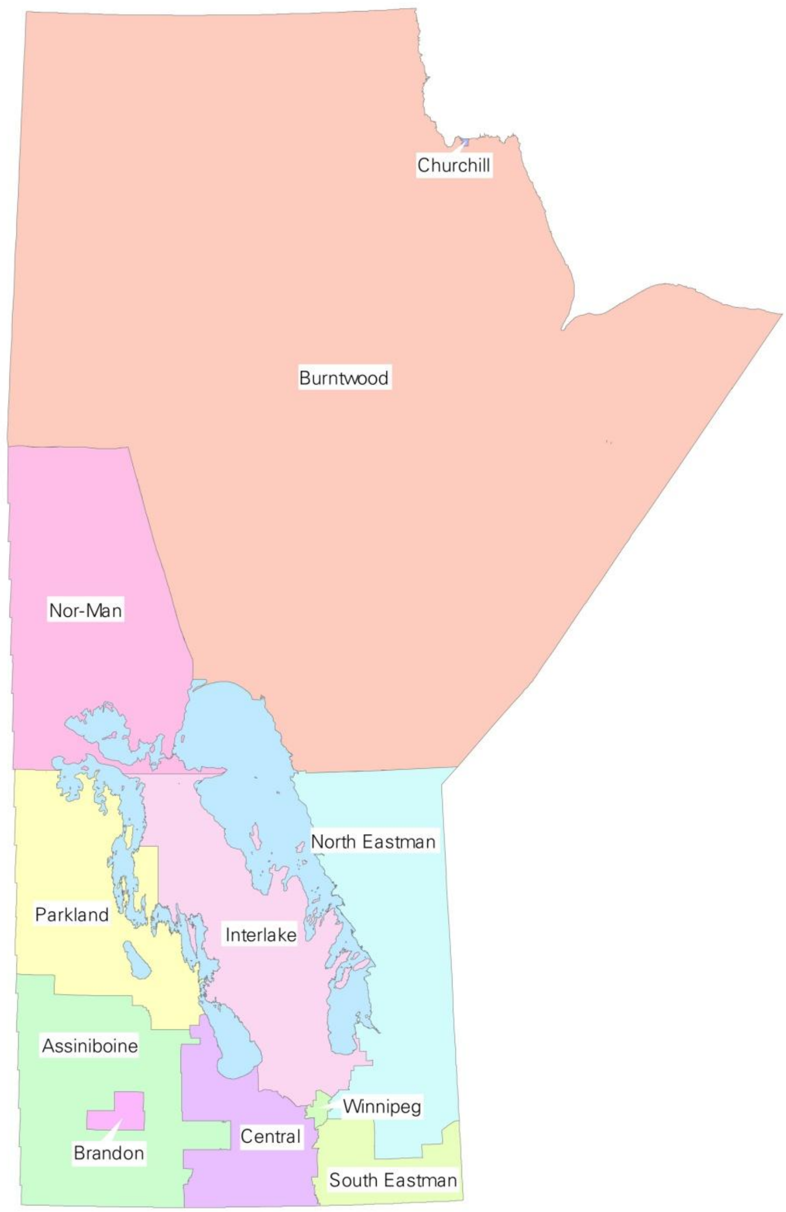
Appendix C

Complete listing of crude prevalence and proportion results

		Number with ADHD	General Population	Crude Prevalence (Per 100 Persons)	Lower Confidence Interval	Upper Confidence Interval
Lifetime Diagnosis of ADHD		14762	207544	7.11	7.00	7.23
Sex	Male	10803	104856	10.30	10.11	10.50
	Female	3959	102688	3.86	3.74	3.98
UrbRHA	Urban	10182	125309	5.57	5.41	5.73
	Rural	4580	82235	8.13	7.97	8.28
RHA	Burntwood	365	10146	3.60	3.25	3.99
	Nor-Man	174	4318	4.03	3.47	4.68
	Parkland	332	6494	5.11	4.59	5.69
	South Eastman	683	12096	5.65	5.24	6.09
	Central	1089	18985	5.74	5.41	6.09
	North Eastman	404	6612	6.11	5.54	6.74
	Assiniboine	677	10959	6.18	5.73	6.66
	Interlake	841	12472	6.74	6.30	7.21
	Brandon	739	9375	7.88	7.33	8.47
	Winnipeg	9443	115934	8.15	7.98	8.31
	Churchill	15	153	9.80	5.91	16.26
Age Group	18-19	4733	51962	9.11	8.85	9.37
	20-21	2638	32640	8.08	7.78	8.40
	22-23	2380	32003	7.44	7.14	7.74
	24-25	1959	31028	6.31	6.04	6.60
	26-27	1693	30331	5.58	5.32	5.85
	28-29	1359	29580	4.59	4.36	4.85
Income Quintile	NF	109	715	15.24	12.64	18.39
	Q1	2881	43653	6.60	6.36	6.85
	Q2	2910	41285	7.05	6.80	7.31
	Q3	2842	39991	7.11	6.85	7.37
	Q4	2931	40472	7.24	6.98	7.51
	Q5	3089	41428	7.46	7.20	7.72
Income Quintile by UrbRHA	NF	109	715	15.24	12.64	18.39
	R1	785	17498	4.49	4.18	4.81
	R2	832	16184	5.14	4.80	5.50
	R3	902	16017	5.63	5.28	6.01
	R4	944	15597	6.05	5.68	6.45
	R5	1101	16747	6.57	6.20	6.97
	U1	2096	26155	8.01	7.68	8.36
	U2	2078	25101	8.28	7.93	8.64
	U3	1940	23974	8.09	7.74	8.46
	U4	1987	24875	7.99	7.64	8.35
	U5	1988	24681	8.05	7.71	8.42
Psychostimulant Treatment	Ever Received	6403	207544	3.09	3.01	3.16
	During Childhood	5202	207544	2.51	2.44	2.57
	During Adulthood	1490	207544	0.72	0.68	0.76
	During Childhood Only	4913	207544	2.37	2.30	2.43
	During Adulthood Only	1201	207544	0.58	0.55	0.61

Appendix D

Map of Manitoba with labeled regional health authorities used in this study



Appendix E

Tables of matching ratio frequencies and percentages for each set of matched cohort analyses

Table 1

ADHD: General population matching frequencies and percentages

Match	Frequency	Percent
1	1	0.01
2	1	0.01
3	88	0.60
4	14562	99.39
	14652	**100.00**
	Unmatched = 1	

Table 2

ADHD: General population matching frequencies and percentages for the high school graduation analysis

Match	Frequency	Percent
1	5	0.04
2	12	0.10
3	92	0.78
4	11624	99.07
	11733	**100.00**
	Unmatched = 5	

Table 3

ADHD: Asthma matching frequencies and percentages

Match	Frequency	Percent
1	3032	38.96
2	4869	30.86
3	2061	17.84
4	4616	12.34
	14578	**100.00**
	Unmatched = 75	

Table 4

ADHD: Asthma matching frequencies and percentages for the high school graduation analysis

Match	Frequency	Percent
1	2695	23.11
2	4210	36.10
3	1422	12.19
4	3335	28.60
	11662	**100.00**

Unmatched = 76

Table 5

ADHD (with no comorbid asthma): Asthma matching frequencies and percentages

Match	Frequency	Percent
1	665	6.97
2	2414	25.31
3	2105	22.07
4	4355	45.65
	9539	**100.00**

Unmatched = 10

Table 6

ADHD (with no comorbid asthma): Asthma matching frequencies and percentages for the high school graduation analysis

Match	Frequency	Percent
1	183	2.38
2	1592	20.70
3	2062	26.81
4	3853	50.10
	7690	**100.00**

No education data = 1853

Unmatched = 6

Appendix F

ADHD: General population crude prevalence of outcome variables by case

Table 1

Crude prevalence of depression by case (i.e., ADHD vs. general population)

	Depression			
Case	**0**	**1**	**Total**	**Percent**
0	57347	1168	58515	2.00
1	12668	1984	14652	13.54

Table 2

Crude prevalence of anxiety by case (i.e., ADHD vs. general population)

	Anxiety			
Case	**0**	**1**	**Total**	**Percent**
0	57659	856	58515	1.46
1	13363	1289	14652	8.80

Table 3

Crude prevalence of personality disorders by case (i.e., ADHD vs. general population)

	Personality Disorders			
Case	**0**	**1**	**Total**	**Percent**
0	58457	58	58515	0.10
1	14432	220	14652	1.50

Table 4

Crude prevalence of conduct disorder by case (i.e., ADHD vs. general population)

	Conduct Disorder			
Case	**0**	**1**	**Total**	**Percent**
0	58490	25	58515	0.04
1	14491	161	14652	1.10

Table 5

Crude prevalence of substance abuse by case (i.e., ADHD vs. general population)

	Substance Abuse			
Case	**0**	**1**	**Total**	**Percent**
0	58165	350	58515	0.60
1	13965	687	14652	4.69

Table 6

Crude prevalence of income assistance by case (i.e., ADHD vs. general population)

	Income Assistance			
Case	**0**	**1**	**Total**	**Percent**
0	54542	3973	58515	6.79
1	11268	3384	14652	23.10

Table 7

Crude prevalence of high school graduation by case (i.e., ADHD vs. general population)

	High school graduation			
Case	**0**	**1**	**Total**	**Percent**
0	10216	36585	46801	78.17
1	4598	7135	11733	60.81

Table 8

Crude prevalence of any injury by case (i.e., ADHD vs. general population)

	Any injuries			
Case	**0**	**1**	**Total**	**Percent**
0	57558	957	58515	1.64
1	14266	386	14652	2.63

Table 9

Crude prevalence of any injuries as a driver by case (i.e., ADHD vs. general population)

	Any injuries as driver			
Case	**0**	**1**	**Total**	**Percent**
0	58420	95	58515	0.16
1	14622	30	14652	0.20

Table 10

Crude prevalence of any injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. general population)

	Any motor vehicle traffic injuries			
Case	**0**	**1**	**Total**	**Percent**
0	58392	123	58515	0.21
1	14610	42	14652	0.29

Table 11

Crude prevalence of any injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. general population)

	Any other vehicle injuries			
Case	**0**	**1**	**Total**	**Percent**
0	58466	49	58515	0.08
1	14638	14	14652	0.10

Table 12

Crude prevalence of any injuries from poisoning by case (i.e., ADHD vs. general population)

	Any injuries from poisoning			
Case	**0**	**1**	**Total**	**Percent**
0	58482	33	58515	0.06
1	14632	20	14652	0.14

Table 13

Crude prevalence of any injuries from falls by case (i.e., ADHD vs. general population)

	Any injuries from falls			
Case	**0**	**1**	**Total**	**Percent**
0	58376	139	58515	0.24
1	14600	52	14652	0.35

Table 14

Crude prevalence of any injuries from self harm by case (i.e., ADHD vs. general population)

	Any injuries from falls			
Case	**0**	**1**	**Total**	**Percent**
0	58376	139	58515	0.24
1	14600	52	14652	0.35

Table 15

Crude prevalence of any injuries from assault by case (i.e., ADHD vs. general population)

	Any injuries from assault			
Case	**0**	**1**	**Total**	**Percent**
0	58279	236	58515	0.40
1	14558	94	14652	0.64

Table 16

Crude prevalence of any injuries from inanimate mechanical force by case (i.e., ADHD vs. general population)

	Any injuries from inanimate mechanical force			
Case	**0**	**1**	**Total**	**Percent**
0	58377	138	58515	0.24
1	14602	50	14652	0.34

Table 17

Crude prevalence of any injuries from over exertion by case (i.e., ADHD vs. general population)

	Any injuries from over exertion			
Case	**0**	**1**	**Total**	**Percent**
0	58356	159	58515	0.27
1	14605	47	14652	0.32

Table 18

Crude prevalence of any injuries from other injuries by case (i.e., ADHD vs. general population)

	Any injuries from other injuries			
Case	**0**	**1**	**Total**	**Percent**
0	58452	63	58515	0.11
1	14618	34	14652	0.23

Table 19

Crude counts of any injury by case (i.e., ADHD vs. general population)

	Counts of any injury				
Case	**0**	**1**	**2**	**3+**	**Total**
0	57558	816	113	28	58515
1	14266	313	54	19	14652

Table 20

Crude counts of injuries as a driver by case (i.e., ADHD vs. general population)

	Counts of injuries as driver		
Case	**0**	**1+**	**Total**
0	58420	95	58515
1	14622	30	14652

Table 21

Crude counts of injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. general population)

	Counts of motor vehicle traffic injuries			
Case	**0**	**1**	**2+**	**Total**
0	58392	109	14	58515
1	14610	36	6	14652

Table 22

Crude counts of injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. general population)

	Counts of non-traffic, any vehicle injuries		
Case	**0**	**1+**	**Total**
0	58466	49	58515
1	14638	14	14652

Table 23

Crude counts of injuries from poisoning by case (i.e., ADHD vs. general population)

	Counts of injuries from poisoning		
Case	**0**	**1+**	**Total**
0	58482	33	58515
1	14632	20	14652

Table 24

Crude counts of injuries from falls by case (i.e., ADHD vs. general population)

	Counts of injuries from falls			
Case	**0**	**1**	**2+**	**Total**
0	58376	122	17	58515
1	14600	46	6	14652

Table 25

Crude counts of injuries from self harm by case (i.e., ADHD vs. general population)

	Counts of injuries from self harm			
Case	**0**	**1**	**2+**	**Total**
0	58431	78	6	58515
1	14584	55	13	14652

Table 26

Crude counts of injuries from assault by case (i.e., ADHD vs. general population)

	Counts of injuries from assault			
Case	**0**	**1**	**2+**	**Total**
0	58279	214	22	58515
1	14558	79	15	14652

Table 27

Crude counts of injuries from inanimate mechanical force by case (i.e., ADHD vs. general population)

	Counts of injuries from inanimate mechanical force		
Case	**0**	**1+**	**Total**
0	58377	138	58515
1	14602	50	14652

Table 28

Crude counts of injuries from over exertion by case (i.e., ADHD vs. general population)

	Counts of injuries from over exertion		
Case	**0**	**1+**	**Total**
0	58356	159	58515
1	14605	47	14652

Table 29

Crude counts of other injuries by case (i.e., ADHD vs. general population)

	Counts of other injuries		
Case	**0**	**1+**	**Total**
0	58452	63	58515
1	14618	34	14652

Appendix G

ADHD: Asthma crude prevalence of outcome variables by case

Table 1

Crude prevalence of depression by case (i.e., ADHD vs. asthma)

	Depression			
Case	**0**	**1**	**Total**	**Percent**
0	34253	3164	37417	8.46
1	12596	1982	14578	13.60

Table 2

Crude prevalence of anxiety by case (i.e., ADHD vs. asthma)

	Anxiety			
Case	**0**	**1**	**Total**	**Percent**
0	35101	2316	37417	6.19
1	13293	1285	14578	8.81

Table 3

Crude prevalence of personality disorders by case (i.e., ADHD vs. asthma)

	Personality Disorders			
Case	**0**	**1**	**Total**	**Percent**
0	37278	139	37417	0.37
1	14358	220	14578	1.51

Table 4

Crude prevalence of conduct disorder by case (i.e., ADHD vs. asthma)

	Conduct Disorder			
Case	**0**	**1**	**Total**	**Percent**
0	37361	56	37417	0.15
1	14418	160	14578	1.10

Table 5

Crude prevalence of substance abuse by case (i.e., ADHD vs. asthma)

	Substance Abuse			
Case	**0**	**1**	**Total**	**Percent**
0	36442	975	37417	2.61
1	13893	685	14578	4.70

Table 6

Crude prevalence of income assistance by case (i.e., ADHD vs. asthma)

	Income Assistance			
Case	**0**	**1**	**Total**	**Percent**
0	33823	3594	37417	9.61
1	11209	3369	14578	23.11

Table 7

Crude prevalence of high school graduation by case (i.e., ADHD vs. asthma)

	High school graduation			
Case	**0**	**1**	**Total**	**Percent**
0	6228	22493	28721	78.32
1	4555	7107	11662	60.94

Table 8

Crude prevalence of any injury by case (i.e., ADHD vs. asthma)

	Any injuries			
Case	**0**	**1**	**Total**	**Percent**
0	36758	659	37417	1.76
1	14194	384	14578	2.63

Table 9

Crude prevalence of any injuries as a driver by case (i.e., ADHD vs. asthma)

	Any injuries as driver			
Case	**0**	**1**	**Total**	**Percent**
0	37350	67	37417	0.18
1	14548	30	14578	0.21

Table 10

Crude prevalence of any injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. asthma)

	Any motor vehicle injuries			
Case	**0**	**1**	**Total**	**Percent**
0	37330	87	37417	0.23
1	14536	42	14578	0.29

Table 11

Crude prevalence of any injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. asthma)

	Any other vehicle injuries			
Case	**0**	**1**	**Total**	**Percent**
0	37386	31	37417	0.08
1	14564	14	14578	0.10

Table 12

Crude prevalence of any injuries from poisoning by case (i.e., ADHD vs. asthma)

	Any injuries from poisoning			
Case	**0**	**1**	**Total**	**Percent**
0	37392	25	37417	0.07
1	14558	20	14578	0.14

Table 13

Crude prevalence of any injuries from falls by case (i.e., ADHD vs. asthma)

	Any injuries from falls			
Case	**0**	**1**	**Total**	**Percent**
0	37340	77	37417	0.21
1	14526	52	14578	0.36

Table 14

Crude prevalence of any injuries from self harm by case (i.e., ADHD vs. asthma)

	Any injuries from self harm			
Case	**0**	**1**	**Total**	**Percent**
0	37332	85	37417	0.23
1	14510	68	14578	0.47

Table 15

Crude prevalence of any injuries from assault by case (i.e., ADHD vs. asthma)

	Any injuries from assault			
Case	**0**	**1**	**Total**	**Percent**
0	37277	140	37417	0.37
1	14484	94	14578	0.64

Table 16

Crude prevalence of any injuries from inanimate mechanical force by case (i.e., ADHD vs. asthma)

	Any injuries from inanimate mechanical force			
Case	**0**	**1**	**Total**	**Percent**
0	37321	96	37417	0.26
1	14529	49	14578	0.34

Table 17

Crude prevalence of any injuries from over exertion by case (i.e., ADHD vs. asthma)

	Any injuries from over exertion			
Case	**0**	**1**	**Total**	**Percent**
0	37324	93	37417	0.25
1	14531	47	14578	0.32

Table 18

Crude prevalence of any injuries from other injuries by case (i.e., ADHD vs. asthma)

	Any injuries from other injuries			
Case	**0**	**1**	**Total**	**Percent**
0	37361	56	37417	0.15
1	14545	33	14578	0.23

Table 19

Crude counts of any injury by case (i.e., ADHD vs. asthma)

	Counts of any injury				
Case	**0**	**1**	**2**	**3+**	**Total**
0	36758	579	67	13	37417
1	14194	311	54	19	14578

Table 20

Crude counts of injuries as a driver by case (i.e., ADHD vs. asthma)

	Counts of injuries as driver		
Case	**0**	**1+**	**Total**
0	37350	67	37417
1	14548	30	14578

Table 21

Crude counts of injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. asthma)

	Counts of motor vehicle traffic injuries		
Case	**0**	**1+**	**Total**
0	37330	87	37417
1	14536	42	14578

Table 22

Crude counts of injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. asthma)

	Counts of non-traffic, any vehicle injuries		
Case	**0**	**1+**	**Total**
0	37386	31	37417
1	14564	14	14578

Table 23

Crude counts of injuries from poisoning by case (i.e., ADHD vs. asthma)

	Counts of injuries from poisoning		
Case	**0**	**1+**	**Total**
0	37392	25	37417
1	14558	20	14578

Table 24

Crude counts of injuries from falls by case (i.e., ADHD vs. asthma)

	Counts of injuries from falls		
Case	**0**	**1+**	**Total**
0	37340	77	37417
1	14526	52	14578

Table 25

Crude counts of injuries from self harm by case (i.e., ADHD vs. asthma)

	Counts of injuries from self harm			
Case	**0**	**1**	**2+**	**Total**
0	37332	79	6	37417
1	14510	55	13	14578

Table 26

Crude counts of injuries from assault by case (i.e., ADHD vs. asthma)

	Counts of injuries from assault			
Case	**0**	**1**	**2+**	**Total**
0	37277	126	14	37417
1	14484	79	15	14578

Table 27

Crude counts of injuries from inanimate mechanical force by case (i.e., ADHD vs. asthma)

	Counts of injuries from inanimate mechanical force		
Case	**0**	**1+**	**Total**
0	37321	96	37417
1	14529	49	14578

Table 28

Crude counts of injuries from over exertion by case (i.e., ADHD vs. asthma)

	Counts of injuries from over exertion		
Case	**0**	**1+**	**Total**
0	37324	93	37417
1	14531	47	14578

Table 29

Crude counts of other injuries by case (i.e., ADHD vs. asthma)

	Counts of other injuries		
Case	**0**	**1+**	**Total**
0	37361	56	37417
1	14545	33	14578

Appendix H

ADHD (with asthma cases removed): Asthma crude prevalence of outcome variables by case

Table 1

Crude prevalence of depression by case (i.e., ADHD vs. asthma)

	Depression			
Case	**0**	**1**	**Total**	**Percent**
0	26987	2241	29228	7.67
1	8368	1171	9539	12.28

Table 2

Crude prevalence of anxiety by case (i.e., ADHD vs. asthma)

	Anxiety			
Case	**0**	**1**	**Total**	**Percent**
0	27565	1663	29228	5.69
1	8787	752	9539	7.88

Table 3

Crude prevalence of personality disorders by case (i.e., ADHD vs. asthma)

	Personality Disorders			
Case	**0**	**1**	**Total**	**Percent**
0	29123	105	29228	0.36
1	9411	128	9539	1.34

Table 4

Crude prevalence of conduct disorder by case (i.e., ADHD vs. asthma)

	Conduct Disorder			
Case	**0**	**1**	**Total**	**Percent**
0	29177	51	29228	0.17
1	9426	113	9539	1.18

Table 5

Crude prevalence of substance abuse by case (i.e., ADHD vs. asthma)

	Substance Abuse			
Case	**0**	**1**	**Total**	**Percent**
0	28470	758	29228	2.59
1	9118	421	9539	4.41

Table 6

Crude prevalence of income assistance by case (i.e., ADHD vs. asthma)

	Income Assistance			
Case	**0**	**1**	**Total**	**Percent**
0	26752	2476	29228	8.47
1	7434	2105	9539	22.07

Table 7

Crude prevalence of high school graduation by case (i.e., ADHD vs. asthma)

	High school graduation			
Case	**0**	**1**	**Total**	**Percent**
0	5990	18975	24965	76.01
1	3017	4673	7690	60.77

Table 8

Crude prevalence of any injury by case (i.e., ADHD vs. asthma)

	Any injuries			
Case	**0**	**1**	**Total**	**Percent**
0	28691	537	29228	1.84
1	9273	266	9539	2.79

Table 9

Crude prevalence of any injuries as a driver by case (i.e., ADHD vs. asthma)

	Any injuries as driver			
Case	**0**	**1**	**Total**	**Percent**
0	29169	59	29228	0.20
1	9516	23	9539	0.24

Table 10

Crude prevalence of any injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. asthma)

	Any motor vehicle injuries			
Case	**0**	**1**	**Total**	**Percent**
0	29157	71	29228	0.24
1	9510	29	9539	0.30

Table 11

Crude prevalence of any injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. asthma)

	Any other vehicle injuries			
Case	**0**	**1**	**Total**	**Percent**
0	29201	27	29228	0.09
1	9528	11	9539	0.12

Table 12

Crude prevalence of any injuries from poisoning by case (i.e., ADHD vs. asthma)

	Any injuries from poisoning			
Case	**0**	**1**	**Total**	**Percent**
0	29204	24	29228	0.08
1	9521	18	9539	0.19

Table 13

Crude prevalence of any injuries from falls by case (i.e., ADHD vs. asthma)

	Any injuries from falls			
Case	**0**	**1**	**Total**	**Percent**
0	29170	58	29228	0.20
1	9505	34	9539	0.36

Table 14

Crude prevalence of any injuries from self harm by case (i.e., ADHD vs. asthma)

	Any injuries from self harm			
Case	**0**	**1**	**Total**	**Percent**
0	29163	65	29228	0.22
1	9500	39	9539	0.41

Table 15

Crude prevalence of any injuries from assault by case (i.e., ADHD vs. asthma)

	Any injuries from assault			
Case	**0**	**1**	**Total**	**Percent**
0	29113	115	29228	0.39
1	9473	66	9539	0.69

Table 16

Crude prevalence of any injuries from inanimate mechanical force by case (i.e., ADHD vs. asthma)

	Any injuries from inanimate mechanical force			
Case	**0**	**1**	**Total**	**Percent**
0	29150	78	29228	0.27
1	9504	35	9539	0.37

Table 17

Crude prevalence of any injuries from over exertion by case (i.e., ADHD vs. asthma)

	Any injuries from over exertion			
Case	**0**	**1**	**Total**	**Percent**
0	29153	75	29228	0.26
1	9503	36	9539	0.38

Table 18

Crude prevalence of any injuries from other injuries by case (i.e., ADHD vs. asthma)

	Any injuries from other injuries			
Case	**0**	**1**	**Total**	**Percent**
0	29180	48	29228	0.16
1	9520	19	9539	0.20

Table 19

Crude counts of any injury by case (i.e., ADHD vs. asthma)

	Counts of any injury				
Case	**0**	**1**	**2**	**3+**	**Total**
0	28691	475	55	7	29228
1	9273	213	39	14	9539

Table 20

Crude counts of injuries as a driver by case (i.e., ADHD vs. asthma)

	Counts of injuries as driver		
Case	**0**	**1+**	**Total**
0	29169	59	29228
1	9516	23	9539

Table 21

Crude counts of injuries from motor vehicle traffic accidents by case (i.e., ADHD vs. asthma)

	Counts of motor vehicle traffic injuries		
Case	**0**	**1+**	**Total**
0	29157	71	29228
1	9510	29	9539

Table 22

Crude counts of injuries from any vehicle non-traffic accidents by case (i.e., ADHD vs. asthma)

	Counts of non-traffic, any vehicle injuries		
Case	**0**	**1+**	**Total**
0	29201	27	29228
1	9528	11	9539

Table 23

Crude counts of injuries from poisoning by case (i.e., ADHD vs. asthma)

	Counts of injuries from poisoning		
Case	**0**	**1+**	**Total**
0	29204	24	29228
1	9521	18	9539

Table 24

Crude counts of injuries from falls by case (i.e., ADHD vs. asthma)

	Counts of injuries from falls			
Case	**0**	**1**	**2+**	**Total**
0	29170	50	8	29228
1	9505	28	6	9539

Table 25

Crude counts of injuries from self harm by case (i.e., ADHD vs. asthma)

	Counts of injuries from self harm		
Case	**0**	**1+**	**Total**
0	29163	65	29228
1	9500	39	9539

Table 26

Crude counts of injuries from assault by case (i.e., ADHD vs. asthma)

	Counts of injuries from assault			
Case	**0**	**1**	**2+**	**Total**
0	29113	102	13	29228
1	9473	54	12	9539

Table 27

Crude counts of injuries from inanimate mechanical force by case (i.e., ADHD vs. asthma)

	Counts of injuries from inanimate mechanical force		
Case	**0**	**1+**	**Total**
0	29150	78	29228
1	9504	35	9539

Table 28

Crude counts of injuries from over exertion by case (i.e., ADHD vs. asthma)

	Counts of injuries from over exertion		
Case	**0**	**1+**	**Total**
0	29153	75	29228
1	9503	36	9539

Table 29

Crude counts of other injuries by case (i.e., ADHD vs. asthma)

	Counts of other injuries		
Case	**0**	**1+**	**Total**
0	29180	48	29228
1	9520	19	9539

Appendix I

Matched cohort analyses for injury counts of ADHD: general population and ADHD: asthma cohort

ADHD: General population analyses from counts of injuries

The Type 3 GEE statistics indicated that all model covariates for the analysis of counts of hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 1). The rate injury counts in the ADHD cohort is 1.77 times higher than that of the general population (see Table 2). Furthermore, the relative rate of injury counts is significantly higher in males, and incrementally decreases with increasing income quintile (see Table 2).

Table 1

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations for any injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	37.74	<.0001
Sex	1	21.54	<.0001
Age Group	5	9.10	0.1053
Income Quintile	4	43.27	<.0001

Table 2

Relative Rates for ADHD: general population matched cohort hospitalizations for any injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.77	(1.54-2.03)	63.64	<0.0001
Sex				
Male	1.66	(1.32-2.09)	18.87	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.63	(2.15-3.23)	86.12	<0.0001
Q2	1.56	(1.26-1.93)	16.86	<0.0001
Q3	1.27	(1.03-1.56)	5.18	0.0228
Q4	1.16	(0.95-1.42)	2.04	0.1536
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more driver injuries than females, see Tables 3 and 4). Accordingly, the relative rate between the ADHD cohort and the general population cohort for counts of hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 4).

Table 3

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of driver of any vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.99	0.3209
Sex	1	12.72	0.0004
Age Group	5	7.13	0.2109
Income Quintile	4	3.59	0.4636

Table 4

Relative Rates for ADHD: general population matched cohort hospitalizations of driver of any vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.23	(0.84-1.8)	1.13	0.2879
Sex				
Male	2.22	(1.31-3.78)	8.66	0.0033
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females, see Tables 5 and 6). Accordingly, the relative rate between the ADHD cohort and the general population cohort for counts of hospitalizations for injury from a motor vehicle is non-significant (see Table 6).

Table 5

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of motor vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	2.84	0.0919
Sex	1	4.38	0.0363
Age Group	5	1.95	0.8562
Income Quintile	4	4.70	0.3192

Table 6

Relative Rates for ADHD: general population matched cohort hospitalizations of motor vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.41	(0.99-2.01)	3.58	0.0586
Sex				
Male	1.50	(0.99-2.27)	3.68	0.0551
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex and age group (i.e., with males having significantly more non-motor vehicle injuries than females, and younger age groups having more non-motor vehicle injuries that the oldest age group, see Tables 7 and 8). Accordingly, the relative rate between the ADHD cohort and the general population cohort for counts of hospitalizations for injury from a non-motor vehicle is non-significant (see Table 8).

Table 7

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of other vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.14	0.7083
Sex	1	6.76	0.0093
Age Group	5	12.67	0.0267
Income Quintile	4	7.88	0.0959

Table 8

Relative Rates for ADHD: general population matched cohort hospitalizations of other vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.14	(0.6-2.17)	0.15	0.6976
Sex				
Male	2.24	(1.04-4.81)	4.27	0.0389
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	3.77	(0.94-15.06)	3.51	0.0608
Age Group 2: 20 - 21	4.71	(1.13-19.67)	4.51	0.0337
Age Group 3: 22 - 23	3.70	(0.86-15.87)	3.10	0.0781
Age Group 4: 24 - 25	1.72	(0.36-8.16)	0.46	0.4970
Age Group 5: 26 - 27	3.26	(0.72-14.8)	2.34	0.1258
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from falls were statistically significant, with the exception of age group and income quintile (see Table 9). The rate of counts of hospitalizations for falls in the ADHD cohort is 1.58 times higher than that of the general population (see Table 10). Furthermore, the relative rate of counts of falls is significantly higher in males, and significantly higher in the lowest income quintile compared to the highest income quintile (see Table 10).

Table 9

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from falls count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	4.74	0.0294
Sex	1	12.68	0.0004
Age Group	5	3.59	0.6093
Income Quintile	4	6.41	0.1706

Table 10

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from falls count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.58	(1.1-2.25)	6.28	0.0122
Sex				
Male	1.89	(1.26-2.83)	9.37	0.0022
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 11). The rate of counts of hospitalizations for poisoning in the ADHD cohort is 2.59 times higher than that of the general population (see Table 12). Furthermore, the relative rate of counts of poisoning is significantly higher in the lowest two income quintiles, as well as the fourth income quintile, as compared to the highest income quintile (see Table 12).

Table 11

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from poisoning count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	6.29	0.0121
Sex	1	0.15	0.7023
Age Group	5	1.77	0.8794
Income Quintile	4	22.63	0.0001

Table 12

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from poisoning count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.59	(1.49-4.49)	11.45	0.0007
Income Quintile				
Q1	12.83	(3.43-47.95)	14.38	0.0001
Q2	5.33	(1.3-21.88)	5.39	0.0203
Q3	2.56	(0.57-11.46)	1.51	0.2196
Q4	5.34	(1.33-21.49)	5.55	0.0184
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from self harm were statistically significant, with the exception of age group (see Table 13). The rate of counts of hospitalizations for injury from self harm in the ADHD cohort is 4.11 times higher than that of the general population (see Table 14). Furthermore, the relative rate of counts of self harm injuries is significantly higher in females than males, and significantly higher in the lowest and third lowest quintiles, as compared to the highest income quintile (see Table 14).

Table 13

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from self harm count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	18.17	<.0001
Sex	1	10.67	0.0011
Age Group	5	5.14	0.3987
Income Quintile	4	17.08	0.0019

Table 14

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from self harm count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	4.11	(2.81-6.03)	52.56	<0.0001
Sex				
Male	0.40	(0.26-0.6)	19.31	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	4.46	(2.49-7.98)	25.32	<0.0001
Q2	1.64	(0.87-3.12)	2.32	0.1276
Q3	2.00	(1.13-3.57)	5.57	0.0182
Q4	1.61	(0.84-3.07)	2.08	0.1491
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from assault were statistically significant (see Table 15). The rate of counts of hospitalizations for injury from assault in the ADHD cohort is 1.68 times higher than that of the general population (see Table 16). Furthermore, the relative rate of counts of assault injuries is significantly higher in males than females, significantly higher in the second youngest age group compared to the oldest age group, and significantly higher in the lowest two quintiles, as compared to the highest income quintile (see Table 16).

Table 15

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from assault count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	11.67	0.0006
Sex	1	54.62	<.0001
Age Group	5	11.29	0.0458
Income Quintile	4	35.49	<.0001

Table 16

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from assault count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.68	(1.3-2.16)	16.23	0.0001
Sex				
Male	4.19	(2.7-6.49)	41.04	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	1.11	(0.69-1.8)	0.20	0.6567
Age Group 2: 20 - 21	1.90	(1.21-3)	7.70	0.0055
Age Group 3: 22 - 23	1.54	(0.95-2.5)	3.02	0.0825
Age Group 4: 24 - 25	1.05	(0.6-1.81)	0.03	0.8722
Age Group 5: 26 - 27	0.89	(0.53-1.52)	0.17	0.6794
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	3.71	(2.45-5.63)	38.15	<0.0001
Q2	1.93	(1.24-3)	8.43	0.0037
Q3	1.03	(0.65-1.64)	0.01	0.9074
Q4	0.91	(0.57-1.44)	0.18	0.6751
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from inanimate force were statistically significant, with the exception of age group (see Table 17). The rate of counts of hospitalizations for injury from inanimate force in the ADHD cohort is 1.50 times higher than that of the general population (see Table 18). Furthermore, the relative rate of counts of inanimate force injuries is significantly higher in males than females, and significantly higher in the lowest two income quintiles, as compared to the highest income quintile (see Table 18).

Table 17

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from inanimate force count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	4.53	0.0333
Sex	1	56.92	<.0001
Age Group	5	5.65	0.3422
Income Quintile	4	11.30	0.0234

Table 18

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from inanimate force count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.50	(1.09-2.07)	6.09	0.0136
Sex				
Male	5.07	(2.97-8.66)	35.30	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.09	(1.27-3.44)	8.51	0.0035
Q2	1.71	(1.03-2.86)	4.25	0.0393
Q3	1.11	(0.63-1.95)	0.14	0.7075
Q4	1.48	(0.83-2.65)	1.78	0.1816
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., significantly higher rates in the lowest two income quintiles, as compared to the highest income quintile, see Tables 19 and 20). Accordingly, the relative rate of counts of hospitalizations for injury from over exertion in the ADHD cohort compared to the general population is non-significant (see Table 20).

Table 19

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of injury from over exertion count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	1.04	0.3076
Sex	1	0.66	0.4156
Age Group	5	0.93	0.9678
Income Quintile	4	14.32	0.0063

Table 20

Relative Rates for ADHD: general population matched cohort hospitalizations of injury from over exertion count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.18	(0.88-1.6)	1.21	0.2714
Income Quintile				
Q1	5.12	(2.95-8.88)	33.62	<0.0001
Q2	2.40	(1.3-4.42)	7.88	0.0050
Q3	1.34	(0.75-2.39)	0.98	0.3225
Q4	0.83	(0.44-1.56)	0.33	0.5679
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for all other injuries were statistically significant, with the exception of income quintile (see Tables 21 and 22). The rate of counts of hospitalizations for all other injuries in the ADHD cohort is 2.05 times higher than that of the general population (see Table 22). Furthermore, the relative rate of counts of other injuries is significantly higher in males than females, and significantly higher in the youngest compared to the highest age group (see Table 22).

Table 21

Type 3 GEE statistics for ADHD: general population matched cohort hospitalizations of other type of injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	8.34	0.0039
Sex	1	10.60	0.0011
Age Group	5	11.50	0.0423
Income Quintile	4	2.44	0.6558

Table 22

Relative Rates for ADHD: general population matched cohort hospitalizations of other type of injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.05	(1.36-3.09)	11.75	0.0006
Sex				
Male	2.31	(1.27-4.2)	7.53	0.0061
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	2.87	(1.17-7.03)	5.33	0.0210
Age Group 2: 20 - 21	1.89	(0.73-4.87)	1.75	0.1863
Age Group 3: 22 - 23	2.01	(0.78-5.2)	2.08	0.1492
Age Group 4: 24 - 25	1.97	(0.59-6.49)	1.23	0.2678
Age Group 5: 26 - 27	0.97	(0.28-3.32)	0.00	0.9583
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

ADHD: Asthma analyses from counts of injuries

The Type 3 GEE statistics indicated that all model covariates for the analysis of counts of hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 23). The relative rate of injury counts in the ADHD cohort is 1.56 times higher than that of the asthma cohort (see Table 24). Furthermore, the relative rate of injury counts is significantly higher in males, and the rates of the two lowest and second highest income quintiles are significantly higher than that of the highest income quintile (see Table 24).

Table 23

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for any injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	23.62	<.0001
Sex	1	21.54	<.0001
Age Group	5	6.65	0.2478
Income Quintile	4	66.49	<.0001

Table 24

Relative Rates for ADHD: asthma matched cohort hospitalizations for any injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.56	(1.34-1.81)	33.12	<0.0001
Sex				
Male	1.67	(1.32-2.11)	18.31	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.78	(2.27-3.41)	97.46	<0.0001
Q2	1.90	(1.52-2.38)	31.07	<0.0001
Q3	1.18	(0.94-1.49)	2.02	0.1551
Q4	1.41	(1.12-1.78)	8.41	0.0037
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having a significantly higher rate than females, see Tables 25 and 26). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 26).

Table 25

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of driver of any vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.01	0.9405
Sex	1	24.76	<.0001
Age Group	5	7.30	0.1990
Income Quintile	4	4.89	0.2988

Table 26

Relative Rates for ADHD: asthma matched cohort hospitalizations of driver of any vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.02	(0.66-1.57)	0.01	0.9403
Sex				
Male	3.52	(1.98-6.24)	18.50	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females) and income quintile (i.e., with the rate of the lowest income quintile being significantly higher than that of the highest income quintile, see Tables 27 and 28). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from a motor vehicle is non-significant (see Table 28).

Table 27

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of motor vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.81	0.3678
Sex	1	14.72	0.0001
Age Group	5	5.47	0.3610
Income Quintile	4	11.11	0.0253

Table 28

Relative Rates for ADHD: asthma matched cohort hospitalizations of motor vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.21	(0.82-1.78)	0.88	0.3477
Sex				
Male	2.14	(1.41-3.25)	12.64	0.0004
Female	Ref	---	---	---
Income Quintile				
Q1	2.03	(1.17-3.53)	6.33	0.0119
Q2	1.39	(0.78-2.49)	1.24	0.2659
Q3	0.80	(0.4-1.6)	0.39	0.5317
Q4	1.36	(0.79-2.34)	1.23	0.2682
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex (i.e., with males having a significantly higher rate than females) and age group (i.e., with rates incrementally decreasing with age, see Tables 29 and 30). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from a non-motor vehicle is non-significant (see Table 30).

Table 29

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of other vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.01	0.9334
Sex	1	5.07	0.0243
Age Group	5	14.69	0.0118
Income Quintile	4	2.65	0.6174

Table 30

Relative Rates for ADHD: asthma matched cohort hospitalizations of other vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.03	(0.54-1.97)	0.01	0.9329
Sex				
Male	2.17	(1.01-4.66)	3.98	0.0461
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	8.26	(1.15-59.39)	4.40	0.0359
Age Group 2: 20 - 21	7.62	(1-57.97)	3.85	0.0498
Age Group 3: 22 - 23	6.43	(0.81-50.95)	3.11	0.0781
Age Group 4: 24 - 25	4.03	(0.45-35.64)	1.57	0.2108
Age Group 5: 26 - 27	4.45	(0.55-36.21)	1.95	0.1625
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from falls were statistically significant, with the exception of sex and age group (see Table 31). The rate of counts of hospitalizations for falls in the ADHD cohort is 1.75 times higher than that of the asthma cohort (see Table 32). Furthermore, the relative rate of counts of falls is significantly higher in males, and significantly higher in the lowest two income quintiles compared to the highest income quintile (see Table 32).

Table 31

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from falls count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	6.31	0.0120
Sex	1	2.91	0.0879
Age Group	5	3.23	0.6651
Income Quintile	4	13.66	0.0085

Table 32

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from falls count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.75	(1.19-2.57)	8.09	0.0045
Income Quintile				
Q1	2.51	(1.43-4.39)	10.34	0.0013
Q2	2.17	(1.22-3.84)	6.98	0.0082
Q3	1.14	(0.56-2.32)	0.14	0.7128
Q4	1.19	(0.64-2.19)	0.30	0.5861
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 33). The rate of counts of hospitalizations for poisoning in the ADHD cohort is 2.28 times higher than that of the asthma cohort (see Table 34). Furthermore, the relative rate of counts of poisoning is significantly higher in the lowest and second highest income quintiles, as compared to the highest income quintile (see Table 34).

Table 33

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from poisoning count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	4.83	0.0280
Sex	1	0.00	0.9443
Age Group	5	2.03	0.8456
Income Quintile	4	17.24	0.0017

Table 34

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from poisoning count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.28	(1.24-4.2)	7.09	0.0077
Income Quintile				
Q1	10.51	(2.68-41.19)	11.38	0.0007
Q2	4.10	(0.97-17.31)	3.69	0.0549
Q3	2.63	(0.58-11.97)	1.56	0.2118
Q4	5.44	(1.31-22.64)	5.42	0.0199
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from self harm were statistically significant, with the exception of age group (see Table 35). The rate of counts of hospitalizations for injury from self harm in the ADHD cohort is 2.94 times higher than that of the asthma cohort (see Table 36). Furthermore, the relative rate of counts of self harm injuries is significantly higher in females than males, and significantly higher in the lowest and second highest quintiles, as compared to the highest income quintile (see Table 36).

Table 35

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from self harm count analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	**$\chi 2$**	**p-value**
Case	1	12.56	0.0004
Sex	1	8.34	0.0039
Age Group	5	1.75	0.8830
Income Quintile	4	17.40	0.0016

Table 36

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from self harm count analysis

Model Effect	**RR***	**95% CI****	**χ^2**	**p-value**
Case	2.94	(1.94-4.47)	25.60	<0.0001
Sex				
Male	0.45	(0.29-0.7)	12.52	0.0004
Female	Ref	---	---	---
Income Quintile				
Q1	3.59	(2.04-6.33)	19.57	<0.0001
Q2	1.63	(0.91-2.91)	2.68	0.1019
Q3	1.22	(0.67-2.22)	0.44	0.5055
Q4	2.06	(1.14-3.74)	5.73	0.0167
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from assault were statistically significant, with the exception of age group (see Table 37). The rate of counts of hospitalizations for injury from assault in the ADHD cohort is 1.50 times higher than that of the asthma cohort (see Table 38). Furthermore, the relative rate of counts of assault injuries is significantly higher in males than females, and incrementally decreases with increasing income quintile (see Table 38).

Table 37

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from assault count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	7.71	0.0055
Sex	1	47.87	<.0001
Age Group	5	9.74	0.0830
Income Quintile	4	41.40	<.0001

Table 38

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from assault count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.50	(1.16-1.96)	9.32	0.0023
Sex				
Male	4.15	(2.7-6.38)	42.19	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	5.20	(3.3-8.21)	50.23	<0.0001
Q2	2.74	(1.64-4.58)	14.71	0.0001
Q3	1.22	(0.68-2.2)	0.45	0.5039
Q4	1.41	(0.83-2.41)	1.58	0.2081
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from inanimate force were statistically significant, with the exception of sex (i.e., with higher rates in males than females, see Table 39). Accordingly, the relative rate of counts of hospitalizations for injury from inanimate force in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 40).

Table 39

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from inanimate force count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.19	0.6655
Sex	1	44.61	<.0001
Age Group	5	8.40	0.1353
Income Quintile	4	4.16	0.3846

Table 40

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from inanimate force count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.08	(0.75-1.56)	0.19	0.6622
Sex				
Male	5.43	(3.15-9.37)	36.94	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., with relative rates decreasing with increasing income quintile, see Tables 41 and 42). Accordingly, the relative rate of counts of hospitalizations for injury from over exertion in the ADHD cohort compared to the asthma cohort is non-significant (see Table 42).

Table 41

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from over exertion count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	1.27	0.2589
Sex	1	0.59	0.4438
Age Group	5	1.15	0.9498
Income Quintile	4	16.65	0.0023

Table 42

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from over exertion count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.25	(0.88-1.77)	1.52	0.2183
Income Quintile				
Q1	4.87	(2.57-9.24)	23.45	<0.0001
Q2	3.89	(2.02-7.5)	16.50	<0.0001
Q3	1.54	(0.81-2.93)	1.76	0.1850
Q4	1.09	(0.5-2.38)	0.05	0.8264
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for all other injuries were statistically significant, with the exception of sex (i.e., higher in males than females) and age group (i.e., generally decreasing with increasing age, see Tables 43 and 44). Accordingly, the relative rate of counts of hospitalizations for all other injuries in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 44).

Table 43

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of other type of injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	1.35	0.2452
Sex	1	15.80	0.0001
Age Group	5	26.24	0.0001
Income Quintile	4	3.46	0.4847

Table 44

Relative Rates for ADHD: asthma matched cohort hospitalizations of other type of injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.31	(0.84-2.03)	1.45	0.2282
Sex				
Male	2.73	(1.53-4.87)	11.56	0.0007
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	7.33	(1.84-29.24)	7.97	0.0048
Age Group 2: 20 - 21	6.27	(1.56-25.18)	6.71	0.0096
Age Group 3: 22 - 23	7.19	(1.76-29.39)	7.54	0.0060
Age Group 4: 24 - 25	6.04	(1.41-25.82)	5.88	0.0153
Age Group 5: 26 - 27	2.69	(0.58-12.5)	1.59	0.2069
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

Appendix J

ADHD (with asthma cases removed): Asthma Matched Cohort Analysis

As can be observed in Table 1, the Type 3 GEE statistics indicated that all model covariates for the depression analysis were statistically significant. The rate of depression in the ADHD cohort is 1.76 times higher than that of the asthma cohort (see Table 2). Furthermore, the rate of depression is significantly higher in females, incrementally increases with age, and is significantly higher in the lowest and third lowest income quintiles compared to the highest income quintile (see Table 2).

Table 1

Type 3 GEE statistics for ADHD: asthma matched cohort depression analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	142.71	<.0001
Sex	1	198.22	<.0001
Age Group	5	93.90	<.0001
Income Quintile	4	17.24	0.0017

Table 2

Relative Rates for ADHD: asthma matched cohort depression analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.76	(1.65-1.88)	278.92	<0.0001
Sex				
Male	0.41	(0.38-0.43)	686.76	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.52	(0.47-0.59)	124.33	<0.0001
Age Group 2: 20 - 21	0.59	(0.53-0.67)	70.95	<0.0001
Age Group 3: 22 - 23	0.69	(0.61-0.77)	40.44	<0.0001
Age Group 4: 24 - 25	0.71	(0.63-0.8)	32.62	<0.0001
Age Group 5: 26 - 27	0.87	(0.78-0.98)	5.36	0.0206
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.19	(1.07-1.32)	10.71	0.0011
Q2	1.06	(0.96-1.18)	1.44	0.2307
Q3	1.16	(1.05-1.28)	8.52	0.0035
Q4	1.01	(0.91-1.13)	0.08	0.7800
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the anxiety analysis were statistically significant (see Table 3). The rate of anxiety in the ADHD cohort is 1.51 times higher than that of the asthma cohort (see Table 4). Furthermore, the relative rate of anxiety is significantly higher in females, incrementally increases with age, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 4).

Table 3

Type 3 GEE statistics for ADHD: asthma matched cohort anxiety analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	64.89	<.0001
Sex	1	139.07	<.0001
Age Group	5	111.67	<.0001
Income Quintile	4	16.86	0.0021

Table 4

Relative Rates for ADHD: asthma matched cohort anxiety analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.51	(1.39-1.64)	93.44	<0.0001
Sex				
Male	0.49	(0.45-0.53)	285.76	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.43	(0.38-0.5)	132.42	<0.0001
Age Group 2: 20 - 21	0.58	(0.5-0.68)	44.27	<0.0001
Age Group 3: 22 - 23	0.65	(0.56-0.75)	32.70	<0.0001
Age Group 4: 24 - 25	0.78	(0.67-0.9)	11.09	0.0009
Age Group 5: 26 - 27	0.89	(0.78-1.02)	2.80	0.0940
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.20	(1.06-1.35)	8.71	0.0032
Q2	0.91	(0.8-1.04)	1.85	0.1736
Q3	1.06	(0.93-1.2)	0.76	0.3822
Q4	1.02	(0.91-1.14)	0.08	0.7786
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

As noted in Table 5, the Type 3 GEE statistics indicated that all model covariates for the personality disorders analysis were statistically significant. The rate of personality disorders in the ADHD cohort is 4.07 times higher than that of the asthma cohort (see Table 6). Furthermore, the relative rate of personality disorders is significantly higher in females and incrementally increases with age, and is significantly higher in the lowest income quintile compared to the highest income quintile (see Table 6).

Table 5

Type 3 GEE statistics for ADHD: asthma matched cohort personality disorders analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	53.27	<.0001
Sex	1	26.94	<.0001
Age Group	5	21.98	0.0005
Income Quintile	4	14.69	0.0054

Table 6

Relative Rates for ADHD: asthma matched cohort personality disorders analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	4.07	(3.06-5.41)	93.35	<0.0001
Sex				
Male	0.45	(0.35-0.59)	36.85	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.50	(0.33-0.75)	11.39	0.0007
Age Group 2: 20 - 21	0.78	(0.5-1.21)	1.25	0.2635
Age Group 3: 22 - 23	0.47	(0.29-0.75)	10.13	0.0015
Age Group 4: 24 - 25	0.81	(0.51-1.28)	0.84	0.3591
Age Group 5: 26 - 27	1.14	(0.73-1.8)	0.34	0.5575
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	2.19	(1.46-3.3)	14.15	0.0002
Q2	1.32	(0.86-2.04)	1.58	0.2083
Q3	1.37	(0.88-2.13)	1.99	0.1585
Q4	1.20	(0.74-1.94)	0.56	0.4556
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the conduct disorder analysis were statistically significant, with the exception of income quintile (see Table 7). The relative rate of conduct disorder in the ADHD cohort is 6.33 times higher than that of the asthma cohort (see Table 8). Furthermore, the relative rate of conduct disorder is significantly higher in females, and incrementally decreases with age (see Table 8).

Table 7

Type 3 GEE statistics for ADHD: asthma matched cohort conduct disorder analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	38.43	<.0001
Sex	1	5.25	0.0220
Age Group	5	53.12	<.0001
Income Quintile	4	1.90	0.7536

Table 8

Relative Rates for ADHD: asthma matched cohort conduct disorder analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	6.33	(4.35-9.19)	93.54	<0.0001
Sex				
Male	0.60	(0.42-0.86)	7.59	0.0059
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	17.52	(4.37-70.18)	16.36	0.0001
Age Group 2: 20 - 21	4.19	(0.98-17.94)	3.73	0.0534
Age Group 3: 22 - 23	2.15	(0.47-9.82)	0.97	0.3252
Age Group 4: 24 - 25	1.74	(0.32-9.64)	0.41	0.5234
Age Group 5: 26 - 27	1.20	(0.2-6.99)	0.04	0.8429
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the substance abuse analysis were statistically significant, with the exception of sex (see Table 9). The rate of substance abuse in the ADHD cohort is 1.75 times higher than that of the asthma cohort (see Table 10). Furthermore, the relative rate incrementally increases with age, and incrementally decreases with increasing income quintile (see Table 10).

Table 9

Type 3 GEE statistics for ADHD: asthma matched cohort substance abuse analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	50.49	<.0001
Sex	1	0.38	0.5365
Age Group	5	63.56	<.0001
Income Quintile	4	69.40	<.0001

Table 10

Relative Rates for ADHD: asthma matched cohort substance abuse analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.75	(1.55-1.98)	82.62	<0.0001
Age Group				
Age Group 1: 18 - 19	0.44	(0.36-0.54)	63.88	<0.0001
Age Group 2: 20 - 21	0.56	(0.45-0.7)	25.90	<0.0001
Age Group 3: 22 - 23	0.61	(0.48-0.77)	17.05	<0.0001
Age Group 4: 24 - 25	0.76	(0.63-0.93)	7.16	0.0074
Age Group 5: 26 - 27	0.88	(0.69-1.11)	1.17	0.2790
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	2.11	(1.76-2.52)	67.06	<0.0001
Q2	1.38	(1.14-1.66)	10.92	0.0010
Q3	1.18	(0.96-1.44)	2.46	0.1168
Q4	0.99	(0.8-1.23)	0.00	0.9502
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the income assistance analysis were statistically significant (see Table 11). The rate of income assistance in the ADHD cohort is 2.81 times higher than that of the asthma cohort (see Table 12). Furthermore, the relative rate of income assistance is significantly higher in females, incrementally increases with age, and incrementally decreases with increasing income quintile (see Table 12).

Table 11

Type 3 GEE statistics for ADHD: asthma matched cohort income assistance analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	249.71	<.0001
Sex	1	70.94	<.0001
Age Group	5	109.06	<.0001
Income Quintile	4	220.91	<.0001

Table 12

Relative Rates for ADHD: asthma matched cohort income assistance analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.81	(2.61-3.02)	797.08	<0.0001
Sex				
Male	0.58	(0.53-0.63)	132.98	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	0.31	(0.26-0.37)	195.63	<0.0001
Age Group 2: 20 - 21	0.64	(0.55-0.75)	28.96	<0.0001
Age Group 3: 22 - 23	0.66	(0.56-0.77)	26.51	<0.0001
Age Group 4: 24 - 25	0.80	(0.69-0.93)	8.28	0.0040
Age Group 5: 26 - 27	0.92	(0.79-1.07)	1.16	0.2823
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	5.39	(4.71-6.17)	602.63	<0.0001
Q2	2.97	(2.61-3.37)	282.98	<0.0001
Q3	2.21	(1.94-2.5)	148.68	<0.0001
Q4	1.78	(1.56-2.03)	73.61	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the high school graduation analysis were statistically significant (see Table 13). The rate of high school graduation in the ADHD cohort is 0.80 times lower than that of the asthma cohort (see Table 14). Furthermore, the relative rate of high school graduation is significantly higher in females, incrementally decreases with age, and incrementally increases with increasing income quintile (see Table 14).

Table 13

Type 3 GEE statistics for ADHD: asthma matched cohort high school graduation analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	173.46	<.0001
Sex	1	16.09	0.0001
Age Group	5	40.95	<.0001
Income Quintile	4	166.56	<.0001

Table 14

Relative Rates for ADHD: asthma matched cohort high school graduation analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	0.80	(0.78-0.82)	366.76	<0.0001
Sex				
Male	0.94	(0.91-0.97)	17.89	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	2.90	(1.99-4.22)	30.53	<0.0001
Age Group 2: 20 - 21	2.89	(1.98-4.21)	30.51	<0.0001
Age Group 3: 22 - 23	2.88	(1.98-4.2)	30.37	<0.0001
Age Group 4: 24 - 25	2.76	(1.89-4.02)	27.78	<0.0001
Age Group 5: 26 - 27	2.52	(1.72-3.67)	22.79	<0.0001
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	0.58	(0.55-0.61)	416.43	<0.0001
Q2	0.78	(0.76-0.8)	261.97	<0.0001
Q3	0.88	(0.86-0.9)	119.95	<0.0001
Q4	0.94	(0.92-0.95)	47.66	<0.0001
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all model covariates for the analysis of one or more hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 15). The rate of one or more hospitalizations for any

type of injury in the ADHD cohort is 1.43 times higher than that of the asthma cohort (see Table 16). Furthermore, the relative rate one or more injuries is significantly higher in males, and incrementally decreases with increasing income quintile (see Table 16).

Table 15

Type 3 GEE statistics for ADHD: asthma matched cohort one or more hospitalizations for any injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	19.90	<.0001
Sex	1	39.36	<.0001
Age Group	5	5.08	0.4058
Income Quintile	4	48.87	<.0001

Table 16

Relative Rates for ADHD: asthma matched cohort one or more hospitalizations for any injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.43	(1.24-1.64)	25.75	<0.0001
Sex				
Male	1.98	(1.58-2.48)	34.96	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.66	(2.14-3.3)	77.55	<0.0001
Q2	1.76	(1.4-2.21)	24.04	<0.0001
Q3	1.20	(0.94-1.52)	2.18	0.1400
Q4	1.30	(1.03-1.65)	4.77	0.0290
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more driver injuries than females, see Tables 17 and 18). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 18).

Table 17

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more driver of any vehicle analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	$\chi 2$	**p-value**
Case	1	0.14	0.7083
Sex	1	18.06	<.0001
Age Group	5	4.85	0.4347
Income Quintile	4	3.78	0.4369

Table 18

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more driver of any vehicle injury analysis

Model Effect	**RR***	**95% CI****	χ^2	**p-value**
Case	1.09	(0.69-1.73)	0.15	0.7027
Sex				
Male	3.11	(1.62-5.97)	11.68	0.0006
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females) and income quintile (i.e., with the lowest income quintile being significantly higher than the highest income quintile, see Tables 19 and 20). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from a motor vehicle is non-significant (see Table 20).

Table 19

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more motor vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.38	0.5373
Sex	1	11.39	0.0007
Age Group	5	4.12	0.5317
Income Quintile	4	16.81	0.0021

Table 20

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more motor vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.16	(0.74-1.8)	0.41	0.5221
Sex				
Male	2.15	(1.27-3.62)	8.23	0.0041
Female	Ref	---	---	---
Income Quintile				
Q1	2.95	(1.55-5.6)	10.90	0.0010
Q2	2.11	(1.05-4.24)	4.37	0.0366
Q3	1.23	(0.58-2.59)	0.29	0.5895
Q4	2.03	(1.08-3.84)	4.77	0.0289
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females, see Tables 21 and 22). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for one or more hospitalizations for injury from a non-motor vehicle is non-significant (see Table 22).

Table 21

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more other vehicle injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.15	0.6978
Sex	1	5.15	0.0232
Age Group	5	8.38	0.1365
Income Quintile	4	1.80	0.7728

Table 22

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more other vehicle injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.14	(0.59-2.2)	0.16	0.6871
Sex				
Male	2.29	(0.98-5.36)	3.64	0.0565
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from falls were statistically significant, with the exception of age group and income quintile (see Table 23). The rate of one or more hospitalizations for falls in the ADHD cohort is 1.75 times higher than that of the asthma cohort (see Table 24). Furthermore, the relative rate of one or more falls is significantly higher in males than females (see Table 24).

Table 23

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more falls injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	5.21	0.0225
Sex	1	5.58	0.0182
Age Group	5	4.61	0.4659
Income Quintile	4	5.80	0.2143

Table 24

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more falls injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.75	(1.14-2.68)	6.63	0.0100
Sex				
Male	1.75	(1.02-3)	4.19	0.0407
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 25). The rate of one or more hospitalizations for poisoning in the ADHD cohort is 2.39 times higher than that of the asthma cohort (see Table 26). Furthermore, the relative rate of one or more poisoning is significantly higher in the two lowest and second highest income quintiles, as compared to the highest income quintile (see Table 26).

Table 25

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more poisoning injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	6.07	0.0137
Sex	1	1.72	0.1900
Age Group	5	3.05	0.6916
Income Quintile	4	16.10	0.0029

Table 26

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more poisoning injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.39	(1.37-4.18)	9.33	0.0023
Income Quintile				
Q1	9.89	(2.3-42.62)	9.46	0.0021
Q2	3.74	(0.78-17.92)	2.72	0.0988
Q3	2.76	(0.54-13.98)	1.50	0.2210
Q4	4.72	(1.02-21.77)	3.95	0.0468
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from self harm were statistically significant, with the exception of age group and income quintile (see Table 27). The rate of one or more hospitalizations for injury from self harm in the ADHD cohort is 1.91 times higher than that of the asthma cohort (see Table 28). Furthermore, the relative rate of one or more self harm injuries is significantly higher in females than males (see Table 28).

Table 27

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more self harm injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	8.24	0.0041
Sex	1	8.18	0.0042
Age Group	5	2.67	0.7507
Income Quintile	4	8.45	0.0763

Table 28

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more self harm injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.91	(1.31-2.79)	11.38	0.0007
Sex				
Male	0.54	(0.37-0.79)	10.02	0.0015
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of one or more hospitalizations for injury from assault were statistically significant (see Table 29). The rate of one or more hospitalizations for injury from assault in the ADHD cohort is 1.57 times higher than that of the asthma cohort (see Table 30). Furthermore, the relative rate of one or more assault injuries is significantly higher in males than females, significantly higher in the second and third youngest age groups compared to the oldest age group, and significantly higher in the lowest two quintiles, as compared to the highest income quintile (see Table 30).

Table 29

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more assault injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	7.02	0.0081
Sex	1	44.22	<.0001
Age Group	5	11.43	0.0435
Income Quintile	4	38.32	<.0001

Table 30

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more assault injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.57	0.4519	9.18	0.0024
Sex				
Male	5.11	(2.83-9.22)	29.26	<0.0001
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	1.45	(0.68-3.08)	0.91	0.3400
Age Group 2: 20 - 21	2.66	(1.29-5.49)	7.02	0.0081
Age Group 3: 22 - 23	2.38	(1.13-5)	5.21	0.0225
Age Group 4: 24 - 25	1.76	(0.82-3.75)	2.13	0.1445
Age Group 5: 26 - 27	1.62	(0.65-3.99)	1.08	0.2985
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	6.51	(3.79-11.2)	45.96	<0.0001
Q2	3.48	(1.93-6.27)	17.12	<0.0001
Q3	1.23	(0.63-2.42)	0.36	0.5480
Q4	1.47	(0.77-2.81)	1.34	0.2477
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from inanimate force were statistically significant, with the exception of sex (i.e., with males having significantly higher rates than females, see Table 31). Accordingly, the rate of one or more hospitalizations for injury from inanimate force in the ADHD cohort compared to the asthma cohort is non-significant (see Table 32).

Table 31

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more inanimate force injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	1.04	0.3071
Sex	1	33.32	<.0001
Age Group	5	9.43	0.0931
Income Quintile	4	2.49	0.6465

Table 32

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more inanimate force injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.22	(0.84-1.77)	1.13	0.2869
Sex				
Male	5.57	(2.67-11.59)	21.03	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., with rates decreasing with increasing income quintile, see Tables 33 and 34). Accordingly, the relative rate of one or more hospitalizations for injury from over exertion in the ADHD cohort compared to the asthma cohort is non-significant (see Table 34).

Table 33

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more over exertion injury analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	2.42	0.1199
Sex	1	3.81	0.0509
Age Group	5	3.15	0.6764
Income Quintile	4	17.48	0.0016

Table 34

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more over exertion injury analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.39	(0.97-1.99)	3.26	0.0711
Income Quintile				
Q1	4.14	(2.09-8.2)	16.55	<0.0001
Q2	3.19	(1.59-6.4)	10.71	0.0011
Q3	1.90	(0.97-3.71)	3.52	0.0607
Q4	0.77	(0.33-1.82)	0.35	0.5522
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of one or more hospitalizations for all other injuries were statistically significant, with the exception of sex (i.e., higher in males than females) and age group (i.e., with higher rates in the youngest four age groups compared to the oldest age group, see Tables 35 and 36). Accordingly, the rate of one or more hospitalizations for all other injuries in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 36).

Table 35

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for one or more other type of injury analysis

Score Statistics for Type 3 GEE Analysis

Source	**DF**	**$\chi2$**	**p-value**
Case	1	0.13	0.7154
Sex	1	15.82	0.0001
Age Group	5	19.70	0.0014
Income Quintile	4	5.77	0.2170

Table 36

Relative Rates for ADHD: asthma matched cohort hospitalizations for one or more other type of injury analysis

Model Effect	**RR***	**95% CI****	**χ^2**	**p-value**
Case	1.11	(0.65-1.89)	0.14	0.7095
Sex				
Male	3.19	(1.55-6.57)	9.90	0.0017
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	6.92	(0.97-49.18)	3.74	0.0531
Age Group 2: 20 - 21	7.93	(1.1-56.92)	4.24	0.0395
Age Group 3: 22 - 23	10.01	(1.4-71.72)	5.26	0.0218
Age Group 4: 24 - 25	8.78	(1.19-64.58)	4.56	0.0328
Age Group 5: 26 - 27	5.00	(0.63-39.59)	2.33	0.1272
Age Group 6: 28 - 29	Ref	---	---	---
Income Quintile				
Q1	1.71	(0.9-3.26)	2.64	0.1044
Q2	0.72	(0.32-1.64)	0.61	0.4348
Q3	1.25	(0.59-2.63)	0.34	0.5600
Q4	1.14	(0.54-2.39)	0.12	0.7298
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

In summary, the majority of the outcome variables were significant in these models, in the anticipated directions. Similar to the ADHD cohort, with comorbid asthma cases included, versus asthma cohort analyses, there were significant findings for the following variables: depression, anxiety, personality disorders, conduct disorder, substance abuse, income assistance, high school graduation, any injury, injury from falls, injury from poisoning, injury from self harm, and injury from assault. Results from the ADHD cohort (with comorbid asthma cases removed) versus asthma cohort analyses for injury count variables are posted below. The main findings of the injury count results are consistent with the main findings from all other ADHD cohort versus asthma cohort injury variable analyses.

ADHD (with comorbid asthma cases removed): Asthma analyses from counts of injuries

The Type 3 GEE statistics indicated that all model covariates for the analysis of counts of hospitalizations for any type of injury were statistically significant, with the exception of age group (see Table 37). The relative rate of injury counts in the ADHD cohort is 1.61 times higher than that of the asthma cohort (see Table 38). Furthermore, the relative rate of injury counts is significantly higher in males, and the rates of the two lowest and second highest income quintiles are significantly higher than that of the highest income quintile (see Table 38).

Table 37

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations for any injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	23.41	<.0001
Sex	1	36.10	<.0001
Age Group	5	3.90	0.5638
Income Quintile	4	45.87	<.0001

Table 38

Relative Rates for ADHD: asthma matched cohort hospitalizations for any injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.61	(1.37-1.89)	34.62	<0.0001
Sex				
Male	2.00	(1.58-2.54)	32.89	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	2.80	(2.21-3.55)	72.88	<0.0001
Q2	1.86	(1.43-2.42)	21.23	<0.0001
Q3	1.26	(0.97-1.63)	3.08	0.0794
Q4	1.40	(1.07-1.82)	6.23	0.0125
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from being the driver of any type of vehicle were statistically significant, with the exception of sex (i.e., with males having a significantly higher rate than females, see Tables 39 and 40). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from being the driver of any type of vehicle is non-significant (see Table 40).

Table 39

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of driver of any vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	0.46	0.4967
Sex	1	15.85	0.0001
Age Group	5	6.32	0.2762
Income Quintile	4	4.31	0.3660

Table 40

Relative Rates for ADHD: asthma matched cohort hospitalizations of driver of any vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.19	(0.73-1.94)	0.50	0.4782
Sex				
Male	2.98	(1.52-5.85)	10.02	0.0015
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a motor vehicle were statistically significant, with the exception of sex (i.e., with males having significantly more motor vehicle injuries than females) and income quintile (i.e., with the rate of the lowest two and second highest income quintiles being significantly higher than that of the highest income quintile, see Tables 41 and 42). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from a motor vehicle is non-significant (see Table 42).

Table 41

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of motor vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	1.04	0.3084
Sex	1	14.42	0.0001
Age Group	5	3.40	0.6386
Income Quintile	4	14.34	0.0063

Table 42

Relative Rates for ADHD: asthma matched cohort hospitalizations of motor vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.30	(0.81-2.09)	1.20	0.2740
Sex				
Male	2.40	(1.42-4.06)	10.67	0.0011
Female	Ref	---	---	---
Income Quintile				
Q1	3.16	(1.59-6.27)	10.82	0.0010
Q2	2.11	(1.02-4.39)	4.04	0.0444
Q3	1.30	(0.58-2.89)	0.41	0.5239
Q4	1.95	(1.02-3.75)	4.04	0.0443
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from a non-motor vehicle were statistically significant, with the exception of sex (i.e., with males having a significantly higher rate than females) and age group (i.e., with rates incrementally decreasing with age, see Tables 41 and 42). Accordingly, the relative rate between the ADHD cohort and the asthma cohort for counts of hospitalizations for injury from a non-motor vehicle is non-significant (see Table 42).

Table 41

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of other vehicle injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	0.35	0.5528
Sex	1	3.93	0.0474
Age Group	5	9.71	0.0839
Income Quintile	4	1.89	0.7551

Table 42

Relative Rates for ADHD: asthma matched cohort hospitalizations of other vehicle injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.26	(0.62-2.54)	0.40	0.5277
Sex				
Male	2.15	(0.87-5.29)	2.77	0.0961
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from falls were statistically significant, with the exception of age group and income quintile (see Table 43). The rate of counts of hospitalizations for falls in the ADHD cohort is 1.97 times higher than that of the asthma cohort (see Table 44). Furthermore, the relative rate of counts of falls is significantly higher in males than females (see Table 44).

Table 43

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from falls count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	5.77	0.0163
Sex	1	5.42	0.0199
Age Group	5	4.73	0.4501
Income Quintile	4	6.01	0.1987

Table 44

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from falls count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.97	(1.24-3.12)	8.33	0.0039
Sex				
Male	1.78	(1.02-3.1)	4.15	0.0416
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from poisoning were statistically significant, with the exception of sex and age group (see Table 45). The rate of counts of hospitalizations for poisoning in the ADHD cohort is 2.51 times higher than that of the asthma cohort (see Table 46). Furthermore, the relative rate of counts of poisoning is significantly higher in the lowest two and second highest income quintiles, as compared to the highest income quintile (see Table 46).

Table 45

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from poisoning count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	6.56	0.0104
Sex	1	1.45	0.2277
Age Group	5	2.99	0.7015
Income Quintile	4	16.12	0.0029

Table 46

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from poisoning count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.51	(1.45-4.35)	10.82	0.0010
Income Quintile				
Q1	9.80	(2.31-41.64)	9.56	0.0020
Q2	3.71	(0.79-17.55)	2.74	0.0976
Q3	2.74	(0.55-13.71)	1.51	0.2191
Q4	5.22	(1.13-24.02)	4.50	0.0339
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from self harm were statistically significant, with the exception of age group and income quintile (see Table 47). The rate of counts of hospitalizations for injury from self harm in the ADHD cohort is 2.33 times higher than that of the asthma cohort (see Table 48). Furthermore, the relative rate of counts of self harm injuries is significantly higher in females than males (see Table 48).

Table 47

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from self harm count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	9.38	0.0022
Sex	1	6.60	0.0102
Age Group	5	1.50	0.9131
Income Quintile	4	8.41	0.0776

Table 48

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from self harm count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	2.33	(1.54-3.52)	16.08	0.0001
Sex				
Male	0.55	(0.36-0.84)	7.84	0.0051
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that all of the model covariates for the analysis of counts of hospitalizations for injury from assault were statistically significant, with the exception of age group (see Table 49). The rate of counts of hospitalizations for injury from assault in the ADHD cohort is 1.64 times higher than that of the asthma cohort (see Table 50). Furthermore, the relative rate of counts of assault injuries is significantly higher in males than females, and incrementally decreases with increasing income quintile (see Table 50).

Table 49

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from assault count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi 2$	p-value
Case	1	6.83	0.0089
Sex	1	40.24	<.0001
Age Group	5	9.92	0.0776
Income Quintile	4	37.33	<.0001

Table 50

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from assault count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.64	(1.19-2.27)	9.10	0.0026
Sex				
Male	4.78	(2.62-8.72)	25.96	<0.0001
Female	Ref	---	---	---
Income Quintile				
Q1	6.13	(3.48-10.78)	39.47	<0.0001
Q2	3.33	(1.79-6.18)	14.45	0.0001
Q3	1.28	(0.62-2.63)	0.45	0.5022
Q4	1.40	(0.7-2.78)	0.90	0.3416
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from inanimate force were statistically significant, with the exception of sex (i.e., with higher rates in males than females, see Table 51). Accordingly, the relative rate of counts of hospitalizations for injury from inanimate force in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 52).

Table 51

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from inanimate force count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.98	0.3223
Sex	1	34.67	<.0001
Age Group	5	10.83	0.0548
Income Quintile	4	2.75	0.5999

Table 52

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from inanimate force count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.25	(0.82-1.89)	1.06	0.3029
Sex				
Male	6.48	(3.1-13.56)	24.60	<0.0001
Female	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for injury from over exertion were statistically significant, with the exception of income quintile (i.e., with relative rates decreasing with increasing income quintile, see Tables 53 and 54). Accordingly, the relative rate of counts of hospitalizations for injury from over exertion in the ADHD cohort compared to the asthma cohort is non-significant (see Table 54).

Table 53

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of injury from over exertion count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	$\chi2$	p-value
Case	1	2.76	0.0964
Sex	1	2.55	0.1101
Age Group	5	3.22	0.6656
Income Quintile	4	17.40	0.0016

Table 54

Relative Rates for ADHD: asthma matched cohort hospitalizations of injury from over exertion count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.49	(1.01-2.19)	4.03	0.0446
Income Quintile				
Q1	4.50	(2.27-8.89)	18.68	<0.0001
Q2	3.48	(1.71-7.09)	11.81	0.0006
Q3	1.90	(0.98-3.71)	3.59	0.0582
Q4	0.77	(0.33-1.81)	0.35	0.5526
Q5	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*

The Type 3 GEE statistics indicated that none of the model covariates for the analysis of counts of hospitalizations for all other injuries were statistically significant, with the exception of sex (i.e., higher in males than females) and age group (i.e., with higher rates in the youngest four age groups compared to the oldest age group, see Tables 55 and 56). Accordingly, the relative rate of counts of hospitalizations for all other injuries in the ADHD cohort compared to that of the asthma cohort is non-significant (see Table 56).

Table 55

Type 3 GEE statistics for ADHD: asthma matched cohort hospitalizations of other type of injury count analysis

Score Statistics for Type 3 GEE Analysis

Source	DF	χ2	p-value
Case	1	0.43	0.5098
Sex	1	17.43	<.0001
Age Group	5	20.43	0.0010
Income Quintile	4	6.11	0.1910

Table 56

Relative Rates for ADHD: asthma matched cohort hospitalizations of other type of injury count analysis

Model Effect	RR*	95% CI**	χ^2	p-value
Case	1.22	(0.69-2.14)	0.47	0.4908
Sex				
Male	3.43	(1.66-7.06)	11.12	0.0009
Female	Ref	---	---	---
Age Group				
Age Group 1: 18 - 19	8.20	(1.15-58.25)	4.42	0.0355
Age Group 2: 20 - 21	7.78	(1.08-55.96)	4.15	0.0416
Age Group 3: 22 - 23	9.85	(1.37-70.73)	5.17	0.0230
Age Group 4: 24 - 25	9.43	(1.28-69.68)	4.84	0.0278
Age Group 5: 26 - 27	4.96	(0.62-39.3)	2.29	0.1298
Age Group 6: 28 - 29	Ref	---	---	---

**RR refers to Relative Rate; **CI refers to Confidence Interval*