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ORIGINAL PAPER

Trends in psychiatric disorders prevalence and prescription patterns of children in Alberta, Canada

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Abstract

Purpose To describe the trends in the prevalence and incidence of children with psychiatric disorders, the types of medication prescribed, and the type of physician providing the prescriptions.

Method This retrospective study linked six population-based administrative databases (2008–2015) in Alberta, Canada.

Results The prevalence of paediatric psychiatric disorders increased from 12.6 per 100 population in 2008 to 15.0 per 100 population in 2015, while the incidence rate increased from 2.0 per 100 population to 2.2 per 100 population in the same period. The proportion of patients dispensed any psychiatric medication increased from 21.4% in 2008 to 28.2% in 2015. Over the same period, dispensations for antidepressants increased from 7.0% to 11.2% and stimulants to treat ADHD, from 11.9% to 15.9%. For antidepressants, general practitioners (GPs) wrote the highest proportion of prescriptions (44.3% in 2011–48.1% in 2015), while paediatricians wrote the lowest proportion (8.7% in 2011–11.0% in 2015) and the proportion by psychiatrists decreased from 33.4% in 2011 to 27.2% in 2015. For stimulants to treat ADHD, paediatricians were the most frequent prescribers (36.9% in 2011–39.3% in 2015) followed by GPs as the second most frequent (33.1% in 2011–33.5% in 2015), while psychiatrists were the least likely to prescribe stimulants for ADHD.

Conclusion The increasing trend of psychiatric diagnoses and medication prescriptions in the paediatric population is evident using population-based administrative databases. The lack of safety and adverse consequences of medication use in this cohort warrants additional monitoring data.

Keywords Paediatric 1 · Psychiatric 2 · Disorders 3 · Prevalence 4 · Incidence 5

Introduction

The growing prevalence and incidence of neuropsychiatric disorders in children is a leading societal concern given the associated human and fiscal costs [1]. According to the global epidemiological data, about one quarter of youth experienced a mental disorder during the past year and about one-third over their lifetimes [2]. Anxiety disorders are the most frequent conditions in children, followed by behavior disorders, mood disorders, and substance use disorders [2]. The worldwide-pooled prevalence of mental disorders is estimated to be 13.4% [3]. In Canada, 12.6% of children and youth aged 4–17 years have been estimated to experience a mental disorder at any given time [4].

The increase in diagnosis of neuropsychiatric disorders is paralleled by the rise of medication prescriptions in the paediatric population. Canadian data indicate an increase in the prescribing of antipsychotic drugs in children and adolescents [5–7]. In British Columbia (BC), the rate of antipsychotic prescriptions increased 3.8-fold for youth aged 18 or younger from 1996 to 2011 [7]. A study of Manitoba administrative health databases reported an increase in second-generation antipsychotics (SGAs) from 1.9 per 1000 in 1999 to 7.4 per 1000 in 2008 [6]. The most common diagnoses linked to antipsychotic use were attention-deficit

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hyperactivity disorder and conduct disorders, and the use of antipsychotics in combination with methylphenidate increased from 13% to 43% [6]. In Ontario, 70% of youth (aged 1–24) with ADHD were prescribed stimulant or non-stimulant ADHD medication [8]. According to the National Longitudinal Survey on Children and Youth medications, prescriptions for Canadian children aged 3–9 years with ADHD increased from 43% in 2000 to 59% in 2007 [9]. A survey of members of the Canadian Academy of Child and Adolescent Psychiatry, and members of the Developmental Paediatrics Section of the Canadian Paediatric Society, found that 12% of all prescriptions were for children under age 9 years [10].

In addition, prescription increases the type of physician prescribing to the paediatric population differed by province. Among all new antipsychotic prescriptions in BC (2010/11), 38.6, 34.3, and 15.6% were provided by psychiatrists, family physicians, and paediatricians, respectively [7], while in Manitoba, general practitioners wrote more than 70% of antipsychotic prescriptions to children and adolescents [6]. Interestingly, psychiatric consultation doubled the odds of medication use for antidepressants and increased 3.8-fold for antipsychotic prescriptions [8].

Children and youth with psychiatric disorders are high-cost healthcare users, with long-term demand on societal infrastructures, including education, social services, policing, and justice [1]. Currently, there is a paucity of information about how many children are being treated for psychiatric disorders and have been prescribed psychiatric medications in Canada.

Canada's public health care system is funded by the federal and provincial governments [11]. Each province and territory has its own health care insurance plan that provides access to hospital and physician services deemed medically necessary. Canadians may access these services without paying out of pocket. Coverage for medication varies by provincial plan. It is within this context that we examine the patterns of childhood psychiatric disorders and prescriptions in the province of Alberta, Canada.

The purpose of this study is to examine the trend in (1) the prevalence and incidence of neuropsychiatric disorders in children; (2) the classes of psychiatric prescriptions for children; and (3) the physician type providing the psychiatric prescriptions in Alberta, Canada for the years 2008–2015 using linked provincial administrative databases.

Methods

This retrospective study used population-based linked administrative databases in Alberta, Canada, to create a cohort of children who were coded in the database to have at least one psychiatric disorder during the study period. This study was approved by the University of Alberta Health Research Ethics Board.

Administrative data sources

The Canadian province of Alberta has a single health authority and a vertically integrated government-funded healthcare delivery system that provides universal coverage for medically necessary care (primarily including hospital based and physician services, but does not generally include medications or elective services) to the province's population of approximately 4.2 million people. Many administrative databases are maintained within the province, and even though their primary function is not for research, they are of high quality and often used for research purposes. Each database contains a unique patient identifier that facilitates linkage to derive information as required. Our cohort was created by linking six provincial administrative databases with data that were relevant to our study; each database is described as follows (and additional details are provided in Supplement Table A):

(a) Discharge Abstract Database (DAD) captures admissions to acute care facilities including dates, a primary diagnosis, and up to 24 secondary diagnoses coded using the Canadian Enhancement of the International Statistical Classification of Diseases, 10th Revision (ICD-10). Diagnosis codes are codes by trained nosologists, and data elements are recorded according to national guidelines set forth by the Canadian Institute for Health Information (https://www.cihi.ca/en/discharge-abstract-database-metadata).
(b) Practitioner Claims Database records physician billing claims and up to three diagnosis codes, coded using the International Statistical Classification of Diseases, 9th Revision (ICD-9). Diagnosis codes do not necessarily represent a confirmed clinical diagnosis (e.g., could be a suspected or working diagnosis), as these data are collected primarily to facilitate payment to physicians by the provincial government, but are commonly used for health research studies.
(c) National Ambulatory Care Reporting System (NACRS, since 2010) and Alberta Ambulatory Care Reporting System (AACRS, before 2010) include visits to emergency departments including relevant dates, a primary diagnosis, and up to 9 secondary diagnoses coded using ICD-10. Diagnosis codes are coded by trained nosologists using national guidelines, and data elements are recorded according to national guidelines set forth by the Canadian Institute for Health Information (https://www.cihi.ca/en/national-ambulatory-care-reporting-system-metadata);
(d) Provincial Registry records death dates;

(e) Pharmaceutical Information Network (PIN) captures over 95% of all prescriptions filled by community pharmacies in the province (data available since 2008) and can be identified using the Anatomical Therapeutic Chemical (ATC) Classification System;
(f) Alberta population estimates include annual population estimates, including breakdown by age and sex.

Cases and cohort

A retrospective cohort was constructed using administrative data from the previously described databases. A case was defined as a child (age ≤ 18 years) who had at least one physician visit or hospitalization with a primary diagnosis code corresponding to one of the psychiatric disorders of interest (see Supplement Table B). If a child has both a hospitalization and a physician visit, he/she is only counted once.

Prevalent cases

For a given year were defined as individuals who met the above criteria in the year of interest, or at any point prior (looking back to 2002 in the inpatient hospitalization (DAD) and practitioner claims databases) and were alive at the start of the year. Therefore, prevalent cases consist of individuals with a first time diagnoses code within each year, as well as individuals who had a diagnosis code in previous years, and assume that once an individual has met the criteria for a condition, they maintain it for the duration of the study period.

Incident cases

For a given year were defined as individuals who had a psychiatric diagnosis code in that year, but did not have a psychiatric diagnosis code at any point prior (looking back to 2002 in the inpatient hospitalization (DAD) and practitioner claims databases). Therefore, within each reporting year, incident cases include only the patients with a first time diagnoses code and are a subset of the prevalent cases.

Variables

The variables extracted from the administrative databases and included in the summary statistics are:

- Demographics: age, sex, urban, or rural residence;
- Psychiatric disorder diagnosis codes (ICD-9 and ICD-10) for Autism Spectrum Disorders, Attachment Disorder, Attention-Deficit/Hyperactivity Disorder/Conduct disorder, Conduct Disorder, Anxiety, Depression, Bipolar disorder, Obsessive–Compulsive Disorder, Oppositional Defiant Disorder, Stress & adjustment disorder, Schizophrenia, and Eating disorder (see Supplement Table B);
- Medical visits related to psychiatric disorder: hospitalizations represent a confirmed diagnosis, since diagnosis codes are assigned by trained nosologists, while physician billing claims indicate a suspected or working diagnosis, but not necessarily with a confirmed clinical diagnosis.
- Health service utilization: hospitalizations and emergency department visits in the prior year for incident cases, and number of visits to medical doctors (including specialists) in the prior year; and
- Prescription fills for psychiatric medications: Antidepressants, Antianxiolytic, Stimulants used to treat ADHD, Non-stimulant meds for ADHD, Antipsychotics, Anticonvulsants/mood stabilizers, Antiadrenergic by Anatomical Therapeutic Chemical (ATC) Classification System, where each code included all lower level codes unless specified otherwise (see Supplement Table C).

Statistical analysis

Characteristics of the prevalent case cohort (which include new and existing cases each year) were summarized by year using frequencies (proportions), and medians (interquartile range [IQR]), as appropriate. Both ICD-9 and ICD-10 codes were included in the calculations due to different databases using the different versions of the ICD. That is, the hospitalizations (DAD) use ICD-10 coding; while the practitioner claims, database uses ICD-9 coding. The proportion of patients in our cohort who were dispensed psychiatric medications was calculated. The top three specialties of the physicians who most often prescribed the medications were determined for the years in which data were available (2011–2015). Data for all other calculations were available from 2008 to 2015. Provincial prevalence and incidence rates were derived by dividing the number of prevalent/incident cases in our cohort each year by the annual provincial population, and multiplying by 1000 to obtain rates per 1000 people residing in the province.

Results

Prevalence of individuals meeting psychiatric definition

The prevalence of individuals meeting our definition for psychiatric disorders in young Albertans increased each year, from 126 per 1000 population in 2008 to 150 per 1000 population in 2015 (see Fig. 1). Prevalence rates increased with age, with males consistently demonstrating higher prevalence of than females, in all age groups. While prevalence rates remained relatively stable in those under 12 years of age, greater increases in prevalence were noted

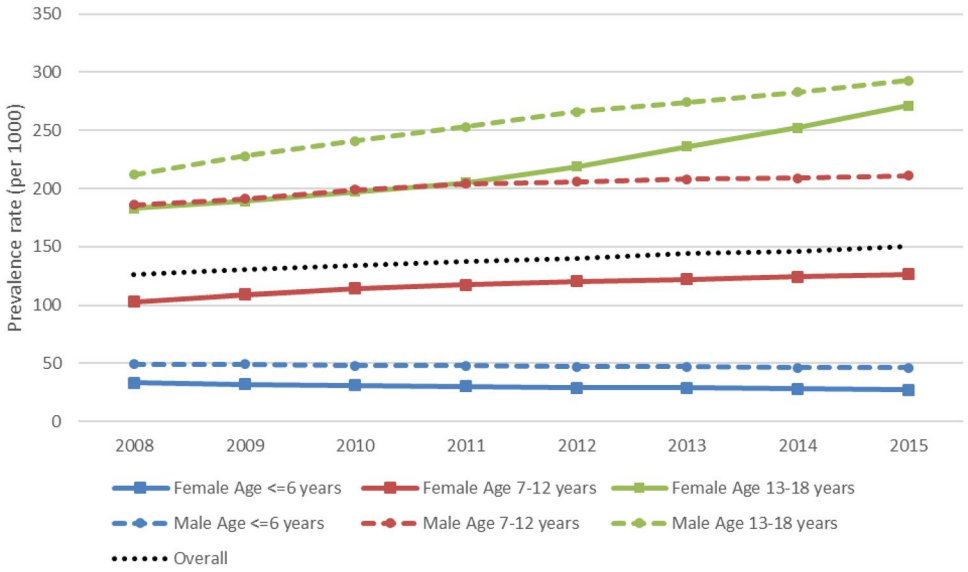

Fig. 1 Prevalence rate (per 1000 population) of individuals meeting psychiatric case definition among Alberta paediatric patients (≤ 18 years) stratified by sex and age from 2008 to 2015

in the 13–18-year-old cohort, with more rapid increases in prevalence among female teenagers. As shown in Table 1, the patient characteristics of prevalent cases showed little change over the course of our study period, with median age of 13 in all years, nearly 60% male, and approximately 15% living in a rural part of the province. The proportion of patients who visited an emergency department was consistently close to 30%, while the proportion of patients hospitalized decreased from 4.6% in 2008 to 3.9% in 2015. Of note, the proportion of patients seen by a psychiatrist decreased from 14.1% in 2008 to 12.3% in 2015, while the proportion of patients seeing a paediatrician increased from 28.5% to 32.1%. General practitioner (GP) utilization remained relatively stable, 75.3% in 2008 to 74.2% in 2015 (see Table 1).

When stratified by sex, the most prevalent disorder in females was anxiety, which increased from 29 per 1000 population in 2008 to 47 per 1000 population in 2015, followed by ADHD (31 per 1000 in 2008–39 per 1000 in 2015), and depression (30 per 1000 in 2008–37 per 1000 in 2015). For males, the most prevalent disorder was ADHD, which increased from 80 per 1000 population in 2008 to 95 per 1000 population in 2015, followed by anxiety (25 per 1000 in 2008–37 per 1000 in 2015) and conduct disorder (34 per 1000 in 2008–37 per 1000 in 2015) (see Table 2).

Table 1 Cohort characteristics for Alberta paediatric psychiatric prevalent cases

Characteristic	2008	2009	2010	2011	2012	2013	2014	2015
No. of patients, *n*	108,676	113,564	117,742	121,987	127,558	133,105	138,365	144,243
Age, median (IQR)	13 (9, 16)	13 (9, 16)	13 (9, 16)	13 (9, 16)	13 (9, 16)	13 (9, 16)	13 (10, 16)	13 (10, 16)
Male, *n* (%)	64,577 (59.4)	67,863 (59.8)	70,571 (59.9)	73,320 (60.1)	76,195 (59.7)	78,552 (59.0)	80,972 (58.5)	83,703 (58.0)
Rural residence, *n* (%)	17,103 (15.7)	17,839 (15.7)	18,328 (15.6)	18,869 (15.5)	19,445 (15.2)	19,974 (15.0)	20,470 (14.8)	20,990 (14.6)
Healthcare utilization								
Any hospitalization, *n* (%)	5001 (4.6)	5067 (4.5)	5131 (4.4)	4983 (4.1)	5328 (4.2)	5602 (4.2)	5747 (4.2)	5607 (3.9)
Any ED visit, *n* (%)	32,640 (30.0)	35,278 (31.1)	34,278 (29.1)	35,992 (29.5)	38,758 (30.4)	40,865 (30.7)	42,429 (30.7)	42,582 (29.5)
Physician visits								
Any psychiatrist, *n* (%)	15,301 (14.1)	15,499 (13.6)	15,703 (13.3)	15,720 (12.9)	16,488 (12.9)	17,059 (12.8)	17,435 (12.6)	17,805 (12.3)
Any paediatrician, *n* (%)	30,963 (28.5)	32,516 (28.6)	33,671 (28.6)	35,395 (29.0)	37,844 (29.7)	41,079 (30.9)	43,863 (31.7)	46,317 (32.1)
Any GP, *n* (%)	81,865 (75.3)	85,785 (75.5)	86,197 (73.2)	90,449 (74.1)	93,925 (73.6)	98,265 (73.8)	10,2730 (74.2)	10,7025 (74.2)

n sample size, *IQR* interquartile range, *AHS* Alberta Health Services, *ED* Emergency Department, *GP* general Practitioner

Table 2 Summary of conditions and medications for prevalent cases each year, stratified by sex

	2008	2009	2010	2011	2012	2013	2014	2015
Female								
Top 5 prevalent conditions (rate per 1000 population)								
Anxiety	29	30	32	33	35	39	42	47
ADHD	31	32	34	35	36	37	38	39
Depression	30	29	29	29	31	34	35	37
Conduct disorder	18	19	19	20	21	21	21	21
Oppositional defiant disorder	20	21	21	21	21	21	21	21
No. of patients in cohort (*n*)	44,099	45,701	47,171	48,666	51,362	54,552	57,392	60,539
Dispensed any psychiatric medication, *n* (%)	8257 (18.7)	9201 (20.1)	9771 (20.7)	10,623 (21.8)	11,766 (22.9)	13,412 (24.6)	14,871 (25.9)	16,558 (27.4)
Top 3 mediations, *n* (%)								
Antidepressants	4070 (9.2)	4506 (9.9)	4803 (10.2)	5238 (10.8)	6115 (11.9)	7355 (13.5)	8357 (14.6)	9728 (16.1)
Stimulants to treat ADHD	3143 (7.1)	3519 (7.7)	3882 (8.2)	4264 (8.8)	4620 (9.0)	5063 (9.3)	5558 (9.7)	6083 (10.0)
Antipsychotics	1535 (3.5)	1597 (3.5)	1668 (3.5)	1830 (3.8)	1983 (3.9)	2299 (4.2)	2439 (4.2)	2712 (4.5)
Male								
Top 5 prevalent conditions (rate per 1000 population)								
ADHD	80	83	86	89	91	92	93	95
Anxiety	25	27	29	30	32	34	36	37
Conduct disorder	34	36	37	38	39	38	38	37
Oppositional Defiant Disorder	30	32	32	32	32	32	32	30
Depression	25	25	25	26	26	26	25	26
No. of patients in cohort (*n*)	64,577	67,863	70,571	73,320	76,195	78,552	80,972	83,703
Dispensed any psychiatric medication, *n* (%)	15,017 (23.3)	16,715 (24.6)	17,986 (25.5)	19,322 (26.4)	20,604 (27.0)	216,99 (27.6)	22,695 (28.0)	24,169 (28.9)
Top 3 medications								
Stimulants to treat ADHD	9820 (15.2)	11,029 (16.3)	12,057 (17.1)	13,017 (17.8)	14,094 (18.5)	14,897 (19.0)	15,787 (19.5)	16,874 (20.2)
Antidepressants	3497 (5.4)	3916 (5.8)	4365 (6.2)	4629 (6.3)	5100 (6.7)	5478 (7.0)	5820 (7.2)	6467 (7.7)
Antipsychotics	3623 (5.6)	3916 (5.8)	4063 (5.8)	4250 (5.8)	4448 (5.8)	4555 (5.8)	4373 (5.4)	4324 (5.2)

Incidence of individuals meeting psychiatric definition

The incidence of new individuals meeting our definition for paediatric psychiatric diagnoses increased by 10% during this same period, from 20 per 1000 population in 2008 to 22 per 1000 population in 2015 (Fig. 2), suggesting that the higher prevalence rates are primarily cumulative rather than a result of increasing incidence in the population per se. While incidence among all age cohorts of males remained relatively stable between 2008 and 2015, the incidence among females in the 7–12 year age group increased from 15 per 1000 population in 2008 to 20 per 1000 population in 2015. Even larger increases in incidence were noted among females in the 13–18-year-old cohort, with an increase from 33 per 1000 population in 2008 to 46 per 1000 population in 2015.

Trends in psychiatric medication prescription

Types of medication prescribed

There was an increasing trend in the proportion of paediatric patients' dispensed psychiatric medications over the study period with an overall increase from 21.4% in 2008 to 28.2% in 2015. The two medications that were most commonly prescribed and had the biggest increase in the same period were antidepressants (7.0%–11.2%) and

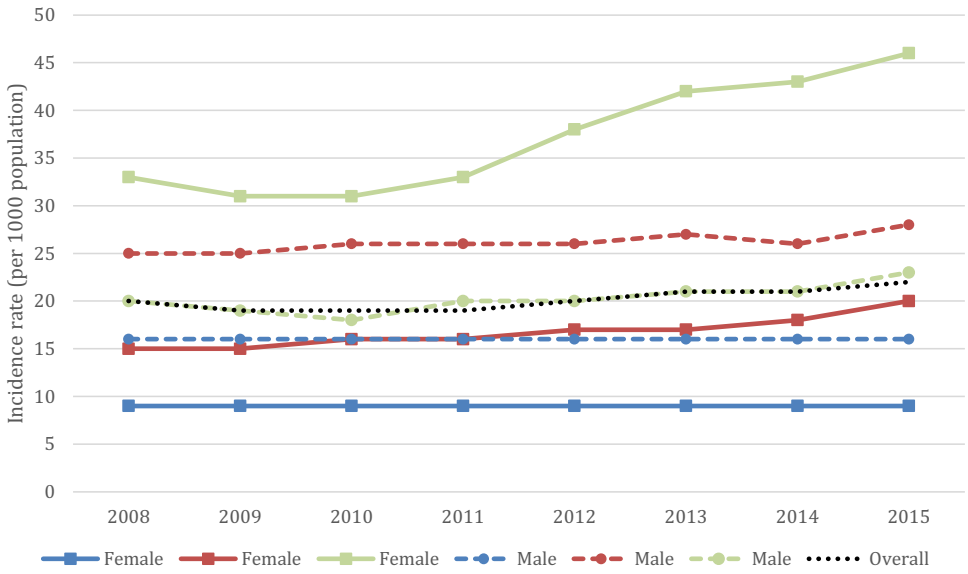

Fig. 2 Incidence rate (per 1000 population) of individuals meeting psychiatric case definition among Alberta paediatric patients (≤ 18 years) stratified by sex and age from 2008 to 2015

stimulants to treat ADHD (11.9%–15.9%). The proportion of patients dispensed psychiatric medication increased in all age groups from 2008 to 2015: 7.8%–10.7% for children 6 years and under, 24.0%–29.3% for children aged 7–12 years, and 22.7%–30.7% for children aged 13–18 years.

While the top three prescriptions were antidepressants, stimulants for ADHD, and antipsychotics, the most commonly prescribed medication differed by sex. Females had the highest prescription for antidepressants (9.2% in 2008–16.1% in 2015), while the highest prescription for males was stimulants used to treat ADHD (15.2% in 2008–20.2% in 2015) (see Table 2).

Types of physician prescribing

As shown in Fig. 3, the largest proportion of antidepressant prescriptions were from GPs, with 4369 (44.3%) in 2011 and 7792 (48.1%) in 2015. Paediatricians wrote the fewest prescriptions for antidepressants, although this proportion did increase from 8.7% in 2011 to 11.0% in 2015. The proportion of antidepressant prescriptions by psychiatrists decreased from 33.4% in 2011 to 27.2% in 2015. Paediatricians were the most frequent prescribers of stimulants to treat ADHD, from 6310 (36.9%) in 2011 to 9026 (39.3%) in 2015, while GPs were second in prescribing these medications, with an increase in prescriptions from 5716 (33.1%)

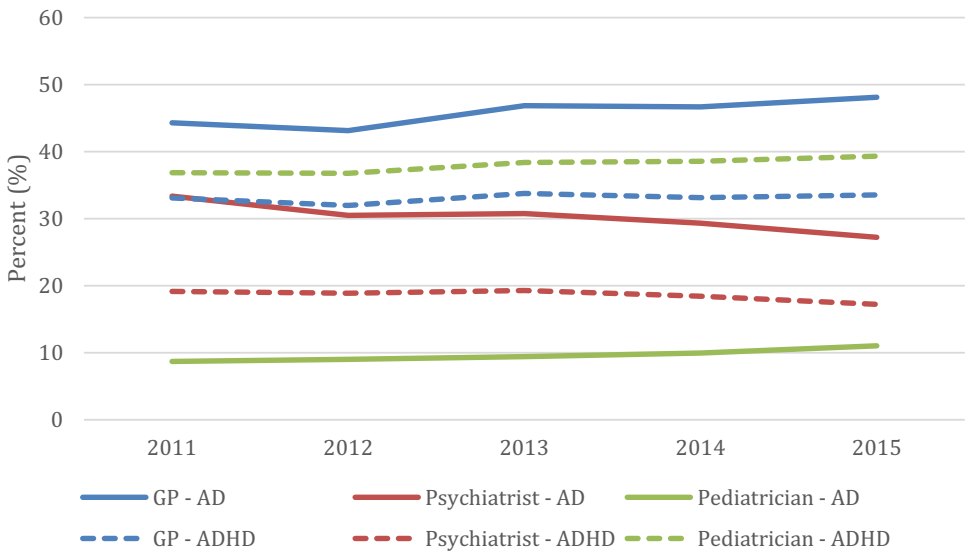

Fig. 3 Percentage of antidepressant (AD) and stimulant-ADHD medications by physician type dispensed to Alberta paediatric patients ≤ 18 years from 2011 to 2015 (period for which data were available)

in 2011 to 7697 (33.5%) in 2015. Psychiatrists were the least likely to prescribe stimulants for ADHD with the proportion decreasing from 19.1% in 2008 to 17.2% in 2015.

There was an increasing trend in prescriptions for antidepressants and stimulants for ADHD based on type of prescribing physician. The percentage of children 6 years or younger receiving a prescription for antidepressants remained relatively constant at approximately 1%, while prescriptions for stimulants increased from 4.3% in 2008 to 6.4% in 2015. Among 7–12 years, the proportion receiving a prescription for antidepressants increased from 3.8% in 2008 to 5.2% in 2015, and for stimulants from 17.3% to 22.8%. However, for those aged 13–18, the proportion of antidepressant prescriptions increased from 10.4% in 2008 to 16.7% in 2011 and for stimulants from 10.1% to 13.3%.

We further stratified prescriptions of antidepressants by physician specialty and noted differences by age group. Among patients 6 years or younger, the most common prescriber of antidepressants was paediatricians (43.1% in 2015) followed by psychiatrists (37.4%) and GPs (7.5%). Within the 7–12-year-old group, psychiatrists were the most common prescribers of antidepressants (39.5% in 2015) followed by paediatricians (26.0%) and GPs (20.7%). Among the 13–18-year-old group, the most common prescribers of antidepressants were GPs (53.9% in 2015), followed by psychiatrists (24.7%) and paediatricians (7.7%).

We also stratified prescriptions of stimulants for ADHD by the type of physician and by age group. In 2015, the most common prescriber of stimulants for ADHD to those 6 years and younger were paediatricians (57.2%), followed by GPs (18.7%), and psychiatrists (14.1%). A similar pattern was observed within the 7–12-year-old group with paediatricians prescribing 47.9% of stimulants for ADHD, followed by GPs (26.9%) and psychiatrists (14.8%). GPs prescribed 41.8% of stimulant medications for ADHD among the 13–18-year-old group, followed by paediatricians (28.7%) and psychiatrists (19.9%).

Discussion

This study used linked provincial administrative databases in Alberta, Canada to analyze the prevalence and incidence of psychiatric diagnoses, the trend in psychiatric prescriptions, and type of prescribing physicians for the paediatric population. The prevalence of individuals meeting our definition of psychiatric disorders in our study was consistent with a 2014 report by Waddell and colleagues that estimated 12.6% of Canadian children and youth aged 4–17 years experienced mental disorders at any given time [4]. The increase of psychiatric medication prescriptions in Albertan children was also consistent with the previous studies, which have identified this trend in BC [7], Saskatchewan [12], Manitoba [6], and Canada [9, 13]. In fact, the dispensing of antidepressants to paediatric patients increased in Canada by 63% between 2010 and 2013 [13]. While earlier Canadian studies noted an initial reduction in antidepressant prescription to paediatric patients following the regulatory warnings from Health Canada in 2004 [14, 15], these findings and recent studies [12, 16] suggest that Canadian physicians are increasingly prescribing antidepressants to this population.

Our study is a first to demonstrate a shifting trend in the types of physicians prescribing antidepressants by age group. Among those 6 years and younger, the proportion of prescriptions written by psychiatrists and GPs decreased over this 8-year period, with an approximately 20% drop in the proportion of prescriptions by psychiatrists to this youngest group. Paediatricians played the largest role in the prescribing of antidepressant medications to the youngest cohort. While psychiatrists were the most common prescribers of antidepressants within the 7–12-year-old group, the proportion of antidepressant prescriptions written by paediatricians increased, and the proportion written by psychiatrists decreased by approximately 10% over the study period. Therefore, paediatricians also appear to be increasingly playing a larger role in prescribing antidepressants to those in the 7–12-year-old group. Among the 13–18-year-old age group, GPs were the most common prescriber of antidepressants and the proportion increased moderately among this group of physicians (approximately 3%) during the study period. While the role of paediatricians in prescribing antidepressants to Albertan teens increased by approximately 1%, the proportion of prescriptions by psychiatrists decreased by just over 4%.

Similar to antidepressant prescription patterns, the proportion of stimulant prescriptions to treat ADHD written by paediatricians increased in all age cohorts, while the proportion of these prescriptions written by psychiatrists decreased in all age group. There was also an increase in the proportion of stimulant prescriptions to manage ADHD written by GPs for those aged six and under, and among teenaged cases between 13 and 18 years. To our knowledge, our study is the only one to examine these trends in Alberta to date, and very few Canadian studies have examined paediatric prescription practices based on physician type for antidepressants, and stimulants for ADHD [12, 13, 16]. The current findings from Alberta depart slightly from findings in a national study of paediatric SSRI pharmacoepidemiology between 2005 and 2009, which also noted increased use of these medications; however, in the collective Canadian context, psychiatrists had the highest proportion of SSRIs' prescriptions (52%), followed by GPs (37%), and paediatricians (10%) [16]. A second study of paediatric antidepressant use in the Saskatchewan between 1983 and 2007 also showed increased dispensing of antidepressants over the study period among all medical specialties, but GPs were the major prescribers,

followed by psychiatrists in that province [12]. These findings also differ from patterns documented in studies of BC antipsychotic prescription, where psychiatrists had the highest prescription for antipsychotics [7], and general practitioners wrote more than 70% of the prescriptions for antipsychotics [6].

We were unable to determine a clear rationale for the changes in prescription patterns by physician type using the available administrative data. The number of paediatric visits to psychiatrists increased by just over 2500 visits a year between 2008 and 2015; however, the proportion of psychiatric visits compared to the total number of physician visits decreased by almost 2% in the same period. This may account for the shift in antidepressant and ADHD (stimulants) prescription patterns away from specialist psychiatric care, or may also suggest a proportional under-availability of psychiatric appointments, as the population of Alberta and prevalence of depression have increased. It is also possible that this trend may also be partially a function of changing prescription practices among psychiatrists. Thus, the growing proportion of prescriptions from GPs and paediatricians could be a result of the lack of access to paediatric psychiatric specialists, or an increasing pressure for GPs and paediatricians to manage these cases with medication. Alternately, given the variation in the types of physicians prescribing these medications in different Canadian jurisdictions [12, 16], perhaps, these changing patterns are a result of variations in specialist psychiatric availability in different provincial contexts.

The growing use of psychiatric medication in the paediatric population also posed questions of efficacy and safety. A 2016 meta-analysis in the Lancet found antidepressants to be ineffective for children [17]. Another study found little evidence that increase in medication use was associated with improvements in emotional functioning or academic outcomes among children with ADHD, in either the medium or the long-term [18]. A global study of the World Health Organization's internationally compiled individual case safety reports (ICSRs) database, which has collected case reports of adverse events for over 40 years, found adverse reactions with increased reporting during recent years, particularly those connected to the introduction of ADHD medicines in the child population [19]. The long-term effects of these medications on children's physical and mental development have yet to be determined [20]. Despite the increase in use of these medications in children, the potential endocrine and metabolic adverse effects of psychiatric medications [21] and the long-term effects remain largely unknown.

The societal implication of the current status of psychiatric disorders in children and youth may reflect the number of challenges and systematic failures [22]. Among them, inadequate diagnosis and intervention, long wait times, lack of continuity of care, fragmentation between community- and hospital-based mental health services, as well as between sectors and between service providers of different disciplines, and lack of evidence-informed practice [22]. Furthermore, given the complex social systems, the increase in diagnosis and prescription use in this population [23] may be a consequence of pharmaceutical marketing practices and availability of information of drugs (particular through the Internet) as among the social and technological factors driving this phenomenon [24]. There are also societal and practice myths that have influenced prescribing of psychotropic medications in children and youth, including that "drugs are preferable to alternative treatments and are more successful", which further fuels the growth of psychiatric diagnosis and medication use [25]. Thus, it is important to closely monitor the growing number of medication prescriptions, often for off-label use, [5, 7] and the growing reports of significant adverse events associated with these medications [6].

There are several strengths associated with this study. Linking of administrative databases provided accessible and longitudinal data for an entire jurisdiction. Therefore, it was useful for surveying the prevalence and incidence of chronic diseases such as psychiatric disorders and the trend in medical care (e.g., the number and types of prescription use). This study highlighted the mental health status of children in Alberta, and the extent of psychiatric medications being prescribed in this vulnerable population. We were also able to identify trends in diagnosis and treatment of the paediatric population, which may help to inform decision makers to assess need, as well as the implementation and evaluation of interventions [26]. In addition, this is one of the first studies to determine physician types associated with psychiatric medication prescription in the paediatric population. The use of linked administrative data is less resource intensive then developing and administering a survey; however, it lacks the ability to collect insights and lived experiences of patients.

Our study also has several limitations. First, we relied on administrative databases for defining psychiatric conditions using ICD codes utilizing a case definition (single hospitalization or physician claim) that has not been validated. For example, in the DAD data, the diagnosis represents a true diagnosis, as the code is assigned after the visit is completed by trained nosologists and according to set guidelines, but for practitioner claims, data the diagnosis code do not necessarily represent a true/confirmed diagnosis. Therefore, the results may have overestimated the true prevalence and incidence of psychiatric disorders, as our cases were defined as a single occurrence of the diagnosis codes, which may not be sufficient to confirm a true diagnosis. However, the database would rely on the professionalism of the clinicians to make the proper assessment and provide the most appropriate code. Furthermore, a limitation of the ICD-9 diagnosis codes used in the practitioner claims database is

that they are often coded up to only the first 3 digits. Thus, the ICD-9 code 314.* includes all of "Hyperkinetic syndrome of childhood" and, therefore, includes ADHD and Conduct disorder without the ability to distinguish between them. However, we aimed to capture all possible patients who have the disorders of interest, and thus broadly defined the cases using administrative data sets. Another limitation with the ICD codes is that it is an international classification of disorders, which may not correspond exactly to the Diagnostic and Statistical Manual (DSM) produced by the American Psychiatric Association, and may account for the inconsistency in the terminology. In addition, our medication data only capture medications dispensed, so we do not know if the children actually took the medications or if other prescriptions were written but not filled. Thus, we may be overestimating the number of medications that were actually taken while underestimating the number of medications that were prescribed. We also did not evaluate the quantity or duration of medications, as this is out of scope for this high-level overview. Furthermore, the administrative data did not enable us to analyze adverse effects of medication use in short term or long term, which has been cited by a number of studies as important to evaluate the impact on child health and development. In Alberta, there is no surveillance system to track this type of information. In addition, administrative databases may have coding errors resulting in mislabeling of conditions or drugs; however, the impact of such errors would be very small at the population level. The data came from a single province, Alberta, which is not representative of the Canadian population, and thus, these findings may not be generalized to the national population. Finally, information such as off-label use and safety was not available in the administrative data, because we could only determine whether a drug had been dispensed and not why.

Conclusion

Childhood psychiatric disorders exert a heavy burden to the healthcare system, as well as on societal infrastructures, from schools to social welfare to corrections. Given that childhood psychiatric disorders influence an individual's productivity and functioning from childhood to adulthood, it is important to address these conditions effectively to reduce both the short-term and long-term impacts. There is an increasing trend in psychiatric medications to manage conditions such as depression and ADHD; however, the efficacy and safety of using these medications during childhood remain unclear. There is a lack of evidence-based guidelines and consensus on the use and monitoring of these medications in this age group. Therefore, the prescription trends of these medications in the paediatric population should be monitored, in conjunction with data related to the safety and adverse consequences of these pharmaceuticals, and evidence-informed practice recommendations for their use in childhood.

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Compliance with ethical standards

Conflict of interest The authors are unaware of any real or perceived conflicts of interest.

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