Asthma Hospitalizations Among Children and Youth in Canada: Trends and Inequalities
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- Claudia Sanmartin

Please note that the analyses and conclusions in this chartbook do not necessarily reflect the views of the individuals mentioned above.
About this chartbook

The analysis includes data from the Hospital Morbidity Database (HMDB) housed at the Canadian Institute for Health Information (CIHI) for fiscal years 2006–2007 to 2015–2016 from all provinces and territories, as well as data from Statistics Canada’s 2006–2007 to 2008–2009 Census–Discharge Abstract Database (DAD) linked data, which excludes Quebec.

Supplementary data tables provide additional results by province and territory.
Executive summary

Approximately 15% of children and youth in Canada were living with asthma in 2013–2014, and asthma continues to be one of the leading causes of hospitalization among children and youth. Many of these hospitalizations are considered avoidable if appropriate treatment and management is provided at the primary care level.

Over the past decade, hospitalizations for asthma have declined significantly for both boys and girls, and across all age groups. In spite of this improvement, children and youth living in lower-income neighbourhoods continue to experience significantly higher rates of hospitalization than those living in higher-income neighbourhoods. These income-related inequalities are observed across different age groups and for boys and girls.

In this report, we also found large inequalities in asthma hospitalizations by household education level: children and youth living in households in which the highest level of education was less than high school were 2.3 times more likely to have been admitted to a hospital for asthma than children and youth living in a household in which the highest level of education was a master’s degree or doctorate. This analysis of education-related inequalities was made possible through Statistics Canada’s linkage of hospital data with Canada's long-form census. Linking administrative health and social data in Canada provides new opportunities to further advance the measurement of health inequalities across population subgroups.

Our analysis suggests that there are opportunities to improve asthma management for children and youth, particularly within lower-education and lower-income populations. Promising interventions include tailored patient/parent education and self-management plans, as well as school- and community-based interventions. Moving forward, the rich longitudinal data sets used for this report could be used to monitor interventions for improving asthma management, with a focus on vulnerable subgroups.
Introduction

Health equity is an important component of quality of care and overall health system performance, and it is a growing priority for health care systems in Canada. Measuring inequalities across population subgroups is an important first step in identifying differences that may be considered unfair or unjust and that can be acted on to improve health equity. In Canada, inequalities in health and health care are significant across a range of health indicators and are generally persisting or worsening over time. For example, a 2015 report showed that smoking rates declined over the period 2003 to 2013 for the population on average, yet the smoking rate among people in the lowest income group remained stable. This highlights the importance of examining indicator rates across population subgroups because health improvements are not always equally distributed.

This chartbook examines inequalities in asthma hospitalization by age, sex, income, geographic location and education among children and youth (age 0 to 19) at the provincial/territorial and national levels, as well as patterns over time. This work leverages newly developed recommended definitions for a set of socio-demographic variables (i.e., equity stratifiers) for the measurement of health inequalities. For more information about these equity stratifiers, please see CIHI’s report In Pursuit of Health Equity: Defining Stratifiers for Measuring Health Inequality. These definitions were developed by drawing on the support of a nationally representative expert working group and on standards developed by Statistics Canada.

Asthma is a chronic respiratory condition that is highly prevalent in Canadian children and youth: approximately 15% of those age 1 to 19 were living with asthma in 2013–2014. There are many possible risk factors for developing asthma, including genetic predisposition and exposure to airborne irritants and second-hand smoke.

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i. The Chronic Disease and Injury Indicator Framework uses data from the Canadian Chronic Disease Surveillance System, which identifies prevalent asthma cases in children and youth based on having 1 or more hospitalizations ever or 2 or more physician claims within 2 years.

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Canadians living with asthma may be hospitalized when they experience a severe or life-threatening asthma exacerbation, including worsening coughing and wheezing, chest pain, drowsiness and confusion. Many asthma hospitalizations are considered avoidable if appropriate treatment and management is provided at the primary care level. Hospitalizations and emergency department (ED) visits for asthma are more common among children and youth than among adults; this may be related to the fact that the evidence for diagnosis and treatment is stronger for adults, as well as to challenges associated with diagnosis and treatment for children younger than 6 in particular. Indeed, asthma continues to be a leading cause of hospitalization among children and youth, with more than 6,000 hospitalizations in 2015–2016. Moreover, for every hospitalization, there are approximately 8 ED visits for asthma among this age group.

Effective asthma management includes medication adherence, avoiding asthma triggers and implementing an asthma action plan; however, only 1 in 3 Canadians are properly controlling their asthma. Uncontrolled asthma in childhood is associated with decreased cardiovascular fitness, missed school days and lower health-related quality of life for children. Asthma is also associated with lower productivity and quality of life among caregivers of children with asthma. The treatment and management of asthma, and the related avoidable hospitalizations, are also associated with significant health care costs: in 2015–2016, the average cost per asthma hospitalization for children and youth was estimated to be approximately $2,718. A study from British Columbia estimated that approximately 64% of patients age 5 to 55 had poorly controlled asthma, and these patients accounted for 94% of the direct health care costs of asthma (due to medications, hospitalizations and physician visits). The burden of asthma on patients, caregivers and health care systems points to opportunities for improving patient care and reducing health system costs.
Leveraging linked health and social data to measure health inequalities

This chartbook contains analysis using 2 data sources (see Figure 1):

1. First, to examine overall asthma hospitalization rates stratified by age, sex, province/territory, neighbourhood income and geographic location (i.e., urban versus rural/remote status), we used the Hospital Morbidity Database (HMDB) housed at the Canadian Institute for Health Information (CIHI) for fiscal years 2006–2007 to 2015–2016. To examine trends by neighbourhood-level income and geographic location, we applied Statistics Canada’s Postal Code Conversion File (PCCF+ Version 6D) tool to assign measures of neighbourhood income and urban and rural/remote geographic location to the HMDB data.

2. To further examine asthma hospitalization rates stratified by educational attainment and individual-level income, we used Statistics Canada’s 2006 Census (long-form) linked to the 2006–2007 to 2008–2009 Discharge Abstract Database (DAD); this linkage does not include data from Quebec.

The Methodology section provides additional details about the data sources and linkage, as well as the asthma hospitalization case definition and age-standardized rate calculation. Provincial and territorial results for 2006–2007 to 2015–2016 are available in the supplementary data tables.

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ii. Postal code is an official mark of Canada Post Corporation.
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**Figure 1: Data sources and linkages used in this chartbook**

**Data source 1**
- **CIHI**
  - HMDB
- **Linkage variable**
  - Asthma (age 0 to 19)

**Data source 2**
- **CIHI**
  - DAD*
- **Linkage variables**
  - Date of birth
  - Sex
  - Postal code

**Socio-demographic data**
- **Statistics Canada**
  - PCCF+
  - **Stratifiers**
    - Neighbourhood income
    - Geographic location

**Sources**

**Notes**
- * Excludes Quebec.
- † About 20% of the Canadian population received the long-form census (excluding those in institutions and those who entered Canada after Census Day).

HMDB: Hospital Morbidity Database.
DAD: Discharge Abstract Database.
How do asthma hospitalizations vary by age and sex?
• Children age 0 to 4 had the highest hospitalization rates for asthma compared with older age groups (5 to 9, 10 to 14 and 15 to 19) (Figure 2).
• Higher rates were observed among boys for the younger age groups (0 to 4, 5 to 9 and 10 to 14) and among girls for the oldest age group (15 to 19) (Figure 2).
Discussion

The higher hospitalization rates observed among the youngest children may be related to difficulties diagnosing and treating asthma in this age group. For these younger patients, health care providers must rely on reports from family members or caregivers, rather than respiratory tests such as spirometry, resulting in significant diagnostic and therapeutic uncertainty and higher morbidity. Preschool-age children with asthma symptoms may be diagnosed with a range of conditions, including asthma, acute bronchitis, bronchiolitis, bronchospasms and reactive airway disease. This challenge leads to increased morbidity, delayed diagnosis and suboptimal management of asthma in primary care settings.

The observed sex-related differences are consistent with clinical evidence suggesting that asthma is more prevalent and severe among young boys than girls. This pattern reverses during adolescence, with increased prevalence and severity of asthma symptoms in girls starting at puberty. While sex hormones may modulate asthma pathways, there may also be gender differences in environmental exposures, the perception of asthma symptoms, knowledge of asthma self-management and likelihood of carrying asthma medication. Some research has suggested that asthma is more common among boys because they are born with smaller airways relative to their lung size or because they tend to have more allergies, predisposing them to asthma.
Asthma hospitalization rates are higher among boys than girls for those age 0 to 14.

Figure 2: Asthma hospitalization, by sex and age group, Canada, 2013–2014 to 2015–2016

Note
Results are based on the pooled 3-year average for the most recent years (2013–2014 to 2015–2016). Similar patterns were observed for pooled data from 2006–2007 to 2008–2009 (data not shown).

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
How have asthma hospitalizations changed over time?
Asthma hospitalization rates in children and youth have declined by 50% over the past 10 years (Figure 3).

- Rates decreased for both boys and girls (Figure 3) and across all age groups (Figure 4), with the largest decrease among children younger than 5.
- Rates decreased significantly in all provinces and in Yukon, but there were variations between provinces (Figure 5).
- From 2013–2014 to 2015–2016, rates were significantly higher than the Canadian average in Prince Edward Island, Saskatchewan, Ontario and the Northwest Territories, and were lower than the average in New Brunswick, Quebec, Manitoba, Alberta, British Columbia and Yukon (Figure 5).
Discussion

The substantial decrease in asthma hospitalization rates among children and youth in Canada suggests that there have been improvements in the prevention and/or primary care treatment and management of this disease during the past decade, and that these improvements have affected rates across all age groups and among both boys and girls. These trends in hospitalizations were also noted in the United States and in many European countries.\textsuperscript{26–28}

During this time period, hospital readmission rates attributed to asthma remained fairly stable, with a slight decrease in recent years — from 8.7% of all admissions in 2006–2007 to 7.6% in 2015–2016.\textsuperscript{iii} This may further suggest improvements in disease management and primary care follow-up after an acute care episode. During this time period, there was also a change in the coding direction. Prior to 2009–2010, cases of reactive airway disease (RAD) were classified as Asthma (J45), but from 2009 onward these cases were classified as Other specified respiratory disorders (J98.8). Additional analysis shows that rates for combined asthma and RAD decreased to a similar extent as asthma alone between 2006–2007 and 2015–2016 (asthma alone: 52%; asthma and RAD: 45%).

\textsuperscript{iii} For each fiscal year, readmissions were defined as admissions occurring more than 24 hours after an earlier discharge date.
Asthma hospitalization rates decreased by 50% over the past decade, with 79 per 100,000 fewer cases in 2015–2016 than in 2006–2007.

**Figure 3: Asthma hospitalization (age 0 to 19) by sex, Canada, 2006–2007 to 2015–2016**

Asthma hospitalization rates decreased by 50% over the past decade, with 79 per 100,000 fewer cases in 2015–2016 than in 2006–2007.

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
Asthma hospitalization rates decreased across all age groups, with the highest decrease among children younger than 5.

Notes
The percentage decrease was calculated by subtracting the later age-standardized hospitalization rate per 100,000 population from the earlier rate, dividing by the earlier rate and multiplying by 100%. Results are based on the pooled 3-year average for the most recent years (2013–2014 to 2015–2016). Similar patterns were observed for pooled data from 2006–2007 to 2008–2009 (data not shown).

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
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Figure 5: Asthma hospitalization (age 0 to 19) by province/territory, 2006–2007 to 2008–2009 versus 2013–2014 to 2015–2016

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<td>Nun.</td>
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Asthma hospitalization rates decreased significantly over the past decade for all provinces and Yukon.

- From 2013–2014 to 2015–2016, rates were significantly higher than the Canadian average in Prince Edward Island, Ontario, Saskatchewan and the Northwest Territories.

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
How do asthma hospitalizations vary by neighbourhood income, geographic location and household education?
Inequalities by income

The income-related inequalities presented in this section are based on neighbourhood income quintiles assigned to asthma hospitalization cases. Results based on individual-level income quintiles from the 2006 Census (long-form) linked to the 2006–2007 to 2008–2009 DAD show similar levels of inequality at the national level, and greater inequalities for certain provinces such as Saskatchewan. Individual-level income quintiles generally better reflect a person’s material well-being, such as having the means to purchase goods and services, relative to other individuals; area-level income quintiles encompass the social and economic characteristics of neighbourhoods, including access to health care and other services and amenities, relative to other neighbourhoods. The results using individual-level income quintiles are available in the supplementary data tables.
Key messages

- Inequalities by neighbourhood income have generally persisted over the past 10 years (Figure 6).
- Neighbourhood income–related inequalities are similar for both boys and girls (see supplementary data tables), and are significant for both children and youth (Figure 7).
- Neighbourhood income–related inequalities have persisted over time across all provinces, except in British Columbia (where they appear to have been eliminated). Provincial and territorial results are available in the supplementary data tables.
Discussion

The income-related inequalities observed here are in line with findings from the literature. A recent Ontario study found that asthma hospitalizations and ED visits were greater among children from low-income families and that these children were at higher risk of aggravating their asthma as the proportion of household income spent on out-of-pocket payments for asthma medication increased.\textsuperscript{29} It is also known that children and youth from households with lower incomes are more likely to engage in earlier cigarette use\textsuperscript{30, 31} or be exposed to second-hand smoke.\textsuperscript{32, 33} Smoking or exposure to second-hand smoke are risk factors for asthma exacerbation, particularly in children.\textsuperscript{7, 34} These income-associated environmental factors can lead to asthma hospitalizations or ED visits.\textsuperscript{35} Poor housing conditions (e.g., poor housekeeping, disrepair), which are more common in lower-income populations, are also associated with increased exposure of children with asthma to indoor allergens and air pollution.\textsuperscript{36–38} A recent study of 3 large Canadian cities (Montréal, Vancouver and Toronto) linked increased air traffic pollution (as measured by nitrogen dioxide concentrations) to lower income and suggested that this may in part contribute to the high incidence of air pollution–related diseases, such as asthma, in lower socio-economic status neighbourhoods.\textsuperscript{39}
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Income-related inequalities have persisted over time on a relative scale, with asthma hospitalization rates remaining approximately 1.5 times higher in the lowest-income neighbourhoods compared with the highest-income neighbourhoods.

• In 2015–2016, there were 37 more hospitalizations per 100,000 population in the lowest-income neighbourhoods compared with the highest-income neighbourhoods. As hospitalization rates decreased over time, so did the level of absolute inequality; in 2006, the rate difference was 68 cases per 100,000 between the lowest- and highest-income neighbourhoods.

Note
Results are based on income defined at the neighbourhood level using Statistics Canada's PCCF+ tool. See the Methodology section for more information.

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
There are income-related inequalities in asthma hospitalization rates for both children and youth.

- Among children age 0 to 9, hospitalization rates were 1.5 times higher (or 57 additional cases per 100,000) in the lowest-income neighbourhoods compared with the highest-income neighbourhoods.
- Among youth age 10 to 19, hospitalization rates were 2.0 times higher (or 19 additional cases per 100,000) in the lowest-income neighbourhoods compared with the highest-income neighbourhoods.
Inequalities by geographic location

Geography-related inequalities were calculated by dividing the population of children and youth in Canada into 2 groups based on their postal code, depending on whether they lived in an urban or rural/remote setting.
• In Canada, asthma hospitalization rates are slightly higher in urban areas compared with rural/remote areas (Figure 9), with some variations across provinces and territories.
Figure 8: Geographic distribution of population (age 0 to 19), Canada, 2015–2016

Note
Geographic location was assigned based on Statistics Canada’s Statistical Area Classification type (SACtype): SACtypes 1, 2 and 3 are urban, and SACtypes 4, 5, 6, 7 and 8 are rural/remote. This variable takes into account population size and commuting to large urban centres.42

Source
Discussion

One reason asthma hospitalization rates may be slightly lower in rural and remote areas is because asthma appears to be less prevalent among children in rural than urban regions. This may be due in part to higher environmental exposures in rural and remote areas, which are believed to protect against the development of asthma.40 On the other hand, children with asthma who lived in rural areas were more likely to have severe asthma symptoms than children living in urban areas, and they were less likely to visit a physician until their condition became severe.40 The Canadian Thoracic Society and the Canadian Paediatric Society outline 5 recommendations for referral to asthma specialists, including for severe asthma and when frequent exacerbations persist despite treatment with a moderate dose of inhaled corticosteroids.11 However, one study found that almost one-quarter of rural residents faced difficulty accessing specialist care services,41 likely due to longer travel times to access health care.40, 41
Figure 9: Asthma hospitalization (age 0 to 19), by urban versus rural/remote geographic location, provinces/territories, 2013–2014 to 2015–2016

In Nova Scotia and Ontario, asthma hospitalization rates are significantly higher in urban areas than in rural/remote areas.

- In Canada, urban areas experience slightly higher hospitalization rates than rural/remote areas.

Notes
Data for Yukon and Nunavut was suppressed due to small numbers.
Geographic location was assigned based on Statistics Canada’s Statistical Area Classification type (SACtype): SACtypes 1, 2 and 3 are urban, and SACtypes 4, 5, 6, 7 and 8 are rural/remote. This variable takes into account population size and commuting to large urban centres.42

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
Inequalities by educational attainment

Linking hospital and long-form census data facilitates the analysis of inequality. In this work, educational attainment refers to the highest level of schooling achieved by any member of the household.
Figure 10: Distribution of household educational attainment (age 0 to 19), Canada (excluding Quebec), 2006

Note
Distribution is based on the Canadian population age 0 to 19 (excluding Quebec), estimated using the weighted long-form census.

Source
Key messages

• There are large education-related inequalities, especially among boys (Figure 11).
• Education-related inequalities are observed among both children age 0 to 9 and youth age 10 to 19 (Figure 12).
Discussion

Health literacy, defined as “the degree to which individuals have the capacity to obtain, process and understand basic health information and services to make appropriate health decisions,” is correlated with educational attainment and has been linked to asthma outcomes. In particular, multiple studies reveal that lower levels of health literacy are associated with poorer asthma-related knowledge, management and health outcomes. Lower levels of educational attainment are also associated with increased vulnerability to airborne allergens, as reflected by increased hospitalizations for asthma, perhaps related to the association between lower education and poorer housing quality or residential proximity to sources of air pollution. As well, smoking and exposure to second-hand smoke represent significant risk factors for asthma exacerbations in children and youth, and individuals with lower educational attainment in Canada are more likely to smoke than those with higher levels of education.
There are large education-related inequalities, especially among boys.

Compared with households in which the highest level of education was post-secondary school completion above a bachelor’s degree,

- **Among boys**, hospitalization rates were 2.6 times higher (or 111 additional cases per 100,000) for households in which the highest level of education was less than high school.

- **Among girls**, hospitalization rates were 1.9 times higher (or 41 additional cases per 100,000) for households in which the highest level of education was less than high school.

**Figure 11**: Asthma hospitalization (age 0 to 19), by household educational attainment and sex, Canada (excluding Quebec), 2006–2007 to 2008–2009

Source
**Figure 12:** Asthma hospitalization (age 0 to 19), by household educational attainment and age group, Canada (excluding Quebec), 2006–2007 to 2008–2009

Education-related inequalities were observed in both age groups.

Compared with households in which the highest level of education was post-secondary school completion above a bachelor’s degree,

- Among children age 0 to 9, hospitalization rates were **2.1 times higher** (or **119 additional cases per 100,000**) for households in which the highest level of education was less than high school.

- Among youth age 10 to 19, hospitalization rates were **3.7 times higher** (or **38 additional cases per 100,000**) for households in which the highest level of education was less than high school.

Source
Opportunities to address income- and education-related inequalities

The results of this study suggest that while overall asthma hospitalization rates are declining, there is a disproportionate burden of asthma hospitalizations among children living in lower-income and lower-educated households. Results also show higher rates of hospitalization in urban populations for Nova Scotia and Ontario.

Evidence suggests several opportunities to improve the management of asthma, with particular attention paid to families with lower education and lower income. Some promising interventions are listed below; however, there may be interest in further examining their effectiveness among these vulnerable subgroups.

1. **Self-management planning** includes a written asthma action plan and generally encompasses strategies to self-monitor symptoms, as well as knowledge of when to seek treatment by a health care provider. In children, self-management plans have been shown to improve drug adherence and asthma outcomes in both acute care and non–acute care settings. Educational tools should be adapted for those with low health literacy by removing unnecessary medical terms and including alternative methods of sharing information, such as through drawings or pictures.
2. **A patient–provider partnership** is important for asthma management to elicit the patient’s own goals regarding asthma, which may differ from conventional medical goals, as well as to address differences in patients’ ability to self-manage.\(^5\) Emerging evidence suggests verbal discussions around asthma management education should take priority over written action plans to ensure optimal health outcomes.\(^56\) Clear communication between patients, caregivers and health providers that addresses expectations from all parties increases treatment adherence and may help to reduce the poorer asthma outcomes among children living in households with lower educational attainment.\(^57\) It is suggested that patients and caregivers should be given a chance to voice concerns or questions surrounding proposed asthma management and treatment techniques, especially those related to factors (such as low income or distance from care facilities) that may impact their ability to sufficiently manage the condition and reduce health care utilization, including hospitalization.\(^58\)

3. **School-based interventions**, such as Alberta’s Roaring Adventures of Puff program\(^59\) and the Cincinnati Children’s Hospital Medical Center’s Pursuing Perfection asthma improvement initiative,\(^60\) that incorporate educational sessions and open discussions allow for the dissemination of information on successfully managing asthma to a wide audience, regardless of individual social factors. These and similar interventions undertaken at schools have been shown to have positive clinical and academic effects for their participants.\(^61\)

4. **Community-based interventions**, such as programs targeting environmental asthma triggers like the Lowell Healthy Homes Program\(^62\) and the Addressing Asthma in Englewood Project,\(^63\) allow for the identification and management of widespread causes of asthma exacerbation, like outdoor allergens and mould, and can direct patients to medical and social agencies in their communities. Low socio-economic status, including low income and lower levels of educational attainment, is associated with poorer housing quality.\(^38, 51\) As well, individuals from households with lower levels of educational attainment may be more likely to experience asthma hospitalization with exposure to airborne allergens, compared with those from households with higher levels of educational attainment.\(^50\)
5. **Smoking cessation**, such as programs targeted to vulnerable populations, like the Yes! I Quit smoking cessation program for women with lower educational attainment, may be more effective in reducing smoking rates compared with traditional programs that are not tailored. Smoking and exposure to second-hand smoke are risk factors for asthma hospitalization, particularly among children. In Canada, lower socio-economic status, including lower levels of educational attainment and income, is associated with increased smoking prevalence, and these inequalities are widening over time.

6. **Drug coverage**, such as Quebec's Public Prescription Drug Insurance Plan and Ontario's OHIP+: Children and Youth Pharmacare program, for the costs of asthma medication for children and youth helps address the financial burden that low-income households may face when trying to properly manage asthma. A recent study from Ontario found that individuals younger than 65 who had drug coverage experienced 1.5 times greater odds of having used prescription drugs to treat asthma compared with those without coverage.
Methodology

Data sources

Hospital Morbidity Database
The HMDB captures administrative, clinical and demographic information for all hospital discharges occurring within a fiscal year from acute inpatient facilities (and day surgery facilities in some provinces) for all provinces and territories. The analyses in this report are based on HMDB data for 2006–2007 to 2015–2016, including analyses based on pooled 3-year average data for 2006–2007 to 2008–2009 and for 2013–2014 to 2015–2016.

Statistics Canada’s linkage of the 2006 Census (long-form) and the DAD brings together socio-demographic data (i.e., equity stratifiers) from the long-form 2006 Census of Population and hospital data from the DAD (2006–2007 to 2008–2009); this linkage is available for all provinces and territories except Quebec. As of 2006, CIHI sends annual DAD data to Statistics Canada.
Statistics Canada conducts the census of population every 5 years. Both short- and long-form censuses are conducted. Approximately 20% of households received the long-form census, which included 53 questions on topics such as education, ethnicity, immigration, income and employment. In some regions, all households were asked to complete the long-form census: Nunavut, the Northwest Territories (excluding Yellowknife), Yukon (excluding Whitehorse) and other First Nations reserves and settlements. Because the long-form census was received by the Canadian household population, it does not include the institutionalized population (e.g., residents of long-term care facilities). To make inferences at the population level based on the long-form census, Statistics Canada used sampling weights to account for the survey design and under- or over-representation of certain groups.

The linkage was conducted by Statistics Canada using a hierarchical deterministic approach based on date of birth, sex and postal code. In total, 94% of long-form census records were eligible for linkage to the DAD, and 80% of 2006–2007 DAD records were linked to the census (with similar results for 2007–2008 and 2008–2009). Coverage rates were calculated by dividing the number of hospitalizations among long-form census respondents (based on the linked census–DAD) by the number of hospitalizations in the unlinked DAD. The crude coverage rate was 17% and the weighted coverage rate was approximately 80%; there were variations by jurisdiction. Weighted coverage estimates were expected to be less than 100%, mainly due to differences in the populations covered and linkage error. For example, institutionalized populations, who are high users of hospital services, are represented in the DAD but not in the linked census–DAD data. More information regarding the methodology and validation of the data can be found elsewhere.
Identifying asthma hospitalizations in children and youth

Asthma hospitalizations in children and youth were identified from the HMDB using the following case ascertainment approach. For the provincial/territorial analysis, cases were assigned to provinces/territories based on their residential postal code.

**CIHI inclusions**
1. Asthma hospitalization, defined as a most responsible diagnosis code of
   - ICD-9/9-CM: 493 Asthma
   - ICD-10-CA: J45 Asthma
2. Age at admission younger than 20
3. Sex recorded as male or female
4. Canadian resident (Canadian postal code)

**CIHI exclusions**
1. Records with discharge as death (Discharge Disposition Code = 07)
2. Newborn, stillbirth or cadaveric donor records (Admission Category = N, R or S)
Analytical approach

The following steps were taken to examine inequalities in asthma hospitalization by CIHI and Statistics Canada:

**Step 1:** Categorize the population by equity stratifiers.
**Step 2:** Calculate stratified rates.
**Step 3:** Quantify inequalities using summary measures.
**Step 4:** Identify key findings.

**Step 1: Categorize the population by equity stratifiers**

Data was categorized into population subgroups for 5 equity stratifiers (see Table 1): age, sex, household income (neighbourhood level and individual level), household education, and urban and rural/remote geographic location. For more information about these equity stratifiers, please see CIHI’s report *In Pursuit of Health Equity: Defining Stratifiers for Measuring Health Inequality*. For income, both neighbourhood-level and individual-level household income were used, as they provide complementary information when measuring health inequalities.73
### Table 1  
**Equity stratifiers**

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<td><strong>Neighbourhood-level income quintiles</strong></td>
<td>Neighbourhood income quintiles are a measure of average before-tax income per single-person equivalent in a dissemination area (DA), adjusted for household size (based on 2006 Census data). The average income per person equivalent was used to rank DAs from lowest to highest in each census metropolitan area (CMA), census agglomeration (CA) or provincial residual area not in any CMA or CA. Finally, the population within each area was divided into approximate fifths (i.e., about 20% of DAs in each quintile) to create community-specific income quintiles.</td>
<td>Quintiles (based on distribution of before-tax income) Quintile 1 refers to the lowest income level, while quintile 5 refers to the highest income level.</td>
<td>HMDB-PCCF+: Statistics Canada’s PCCF/PCCF+ Version 6D was used to assign individuals to neighbourhood income quintiles by linking HMDB postal codes to census geography. Note: Measure reflects income levels at the neighbourhood level in 2006.</td>
</tr>
<tr>
<td><strong>Individual-level income quintiles</strong></td>
<td>Within each CMA/CA, or the remainder of the DAs within the province/territory, 20th, 40th, 60th and 80th percentiles were constructed based on the total before-tax income of a household (which is the sum of the total incomes of all members of that household) divided by a scale that assigns a decreasing value to the second and subsequent household members. Finally, for each observation, we determined to which quintile the household income belongs, by comparing with the area-specific percentiles.</td>
<td>Quintiles (based on distribution of before-tax income) Quintile 1 refers to the lowest income level, while quintile 5 refers to the highest income level.</td>
<td>2006 Census linked to the 2006–2007 to 2008–2009 DAD</td>
</tr>
<tr>
<td>Stratifier</td>
<td>Defined as</td>
<td>Categories</td>
<td>Data source</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Household-level educational attainment</td>
<td>Maximum value of self-reported education among all persons in the household.</td>
<td>Less than high school High school Post-secondary school below bachelor’s degree Bachelor’s degree Above bachelor’s degree</td>
<td>2006 Census linked to the 2006–2007 to 2008–2009 DAD</td>
</tr>
<tr>
<td>Urban and rural/remote</td>
<td>Statistical Area Classification type (SACtype) identifies the type of statistical area classification in which the census subdivision is located. There are 8 different SACtypes: SACtype 1: Census subdivision (CSD) within CMA SACtype 2: CSD within CA with at least one census tract SACtype 3: CSD within CA with no census tracts SACtype 4: CSD outside of CMA and CA with strong metropolitan influence (between 30% and &lt;50% commuting flow) SACtype 5: CSD outside of CMA and CA with moderate metropolitan influence (between 5% and &lt;30% commuting flow) SACtype 6: CSD outside of CMA and CA with weak metropolitan influence (between &gt;0% and &lt;5% commuting flow) SACtype 7: CSD outside of CMA and CA with no metropolitan influence SACtype 8: CSD in the territories, outside of a CA</td>
<td>SACtype 1, 2, 3 = urban SACtype 4, 5, 6, 7, 8 = rural/remote</td>
<td>HMDB-PCCF+: Statistics Canada's PCCF/PCCF+ Version 6D was used to link HMDB postal codes to census geographies that can be aggregated as urban and rural/remote.</td>
</tr>
</tbody>
</table>
Step 2: Calculate stratified rates

Age-standardized asthma hospitalization rates per 100,000 population in a given year and for pooled years (2006–2007 to 2008–2009 or 2013–2014 to 2015–2016) were calculated by province/territory and for all equity stratifiers outlined in Table 1. The unit of analysis is a single hospital discharge; this means that individuals can be represented more than once in the numerator if they were hospitalized multiple times during the study period.

For analyses based on the HMDB at CIHI, either a pooled or yearly approach was used. For pooled analyses, the numerator is the sum of all asthma hospitalizations occurring from 2013–2014 to 2015–2016 pooled and/or from 2006–2007 to 2008–2009 pooled; yearly analyses examined 2006–2007 to 2015–2016 data. Denominators are based on population counts available from Statistics Canada.

For analyses based on the 2006 Census linked to the 2006–2007 to 2008–2009 DAD, the numerator is the sum of all linked asthma hospitalizations occurring from 2006–2007 to 2008–2009 pooled; pooling numerators follows the approach used in previous work to reduce the variation that can occur with small numbers. All denominators were based on weighted person counts from the 2006 Census (long-form). For 2007–2008 and 2008–2009, Statistics Canada used an “aging” denominator approach such that in 2007–2008 it excluded everyone younger than 1 and in 2008–2009 it excluded all those younger than 2. The aging denominator approach was used because children born after April 1, 2006, will not be included in the numerator for the census–DAD linkage.

<table>
<thead>
<tr>
<th>Stratifier</th>
<th>Defined as</th>
<th>Categories</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age in years</td>
<td>0 to 9, 10 to 19</td>
<td>HMDB</td>
</tr>
<tr>
<td>Sex</td>
<td>Male or female sex</td>
<td>Male, Female</td>
<td>HMDB</td>
</tr>
</tbody>
</table>
Age-standardization

Rates were age-standardized by the direct method of standardization, using the 2011 Canadian population (from the 2011 Census) as the standard population. Standardization was based on 5-year age groupings.

\[
\text{Age-standardized rate (ASHR) = [Sum over all age groups } j \text{ of } (\text{numerator}_j + \text{denominator}_j) \times \text{weight of standard population}_j \times 100,000}
\]

Measures of precision

Variance was calculated using the following formula:

\[
\text{Variance (ASHR) = [Sum over all age groups } j \text{ of } (\text{numerator}_j + \text{denominator}_j^2) \times \text{weight of standard population}_j^2}
\]

The 95% confidence interval is given by the following:

\[
\text{Lower bound = } \exp\{\log (\text{ASHR}) - 1.96 \times \sqrt{[1 + (\text{ASHR} + 100,000)^2] \times \sqrt{\text{Variance}(\text{ASHR})}}\} \times 100,000
\]

\[
\text{Upper bound = } \exp\{\log (\text{ASHR}) + 1.96 \times \sqrt{[1 + (\text{ASHR} + 100,000)^2] \times \sqrt{\text{Variance}(\text{ASHR})}}\} \times 100,000
\]
Step 3: Quantify inequalities using summary measures

Inequalities between population subgroups were measured on both the absolute and relative scales because, taken together, they provide a more accurate and complete description of inequality than either measure alone. Relative and absolute inequality measures may yield different or even opposing patterns, and relying on only one measure alone may result in different interpretations of inequality trends.

**Table 2  Inequality measures**

<table>
<thead>
<tr>
<th>Rate ratio</th>
<th>Rate difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captures the relative difference and is calculated by dividing the rate of the stratification category with the highest expected hospitalization rate by that with the lowest expected hospitalization rate. The categories used were the lowest income quintile and the highest income quintile (for neighbourhood- and individual-level income analyses), those living in urban areas and those living in rural/remote areas (for geographic location analyses) and education below high school completion and education above bachelor’s degree completion (for educational attainment analyses). Example: Q1 ÷ Q5 = 750 per 100,000 ÷ 250 per 100,000 = 3 <strong>Interpretation:</strong> The rate of condition X is 3 times higher for Canadians in the lowest income quintile than for those in the highest income quintile.</td>
<td>Captures the absolute difference and is calculated by subtracting the rate of the stratification category with the highest expected hospitalization rate by that with the lowest expected hospitalization rate. The categories used were the same as those for calculating the rate ratio. Example: Q1 − Q5 = 750 per 100,000 − 250 per 100,000 = 500 per 100,000 <strong>Interpretation:</strong> 500 more Canadians per 100,000 have condition X in the lowest income quintile than in the highest income quintile.</td>
</tr>
</tbody>
</table>


Step 4: Identify key findings

Key findings were identified by examining statistically significant differences or inequality measures. Significant differences were defined as point estimates with non-overlapping 95% confidence intervals (CIs) between time periods or population groups. Significant inequality measures were defined as rate ratios and rate differences, whereby the 95% CIs did not include 1 or 0, respectively. Notably, this approach of highlighting only statistically significant key findings was taken to overcome the practical challenges of deriving key messages for a comprehensive report in a consistent fashion.
Appendix: Text and table alternatives for figures

**Figure 1** Data sources and linkages used in this chartbook

This figure shows 2 data sources and how each was linked to obtain socio-demographic data (i.e., equity stratifiers) for measuring health inequalities in asthma hospitalization rates for children and youth age 0 to 19.

1. In data source 1, the Hospital Morbidity Database (HMDB) housed at CIHI for 2006–2007 to 2015–2016 was linked via postal code to Statistics Canada’s Postal Code Conversion File Plus (PCCF+). PCCF+ links postal codes to standard census geographic areas. These standard geographies are used to assign individual asthma hospitalization cases to area-based socio-demographic categories, specifically neighbourhood income and geographic location.

2. In data source 2, Statistics Canada’s 2006 Census (long-form) was linked to the 2006–2007 to 2008–2009 Discharge Abstract Database (DAD). The DAD does not include data from Quebec. Approximately 20% of the Canadian population received the long-form census (excluding those in institutions and those who entered Canada after Census Day). The census–DAD linkage was conducted by Statistics Canada based on 3 linkage variables: date of birth, sex and postal code. This linkage assigns household education and individual-level income data from the census to asthma hospitalization cases obtained from the DAD.

**Sources**
Asthma Hospitalizations Among Children and Youth in Canada: Trends and Inequalities

**Figure 2** Asthma hospitalization, by sex and age group, Canada, 2013–2014 to 2015–2016

<table>
<thead>
<tr>
<th>Age group</th>
<th>Hospitalization rate per 100,000 population: Girls</th>
<th>Lower 95% confidence limit: Girls</th>
<th>Upper 95% confidence limit: Girls</th>
<th>Hospitalization rate per 100,000 population: Boys</th>
<th>Lower 95% confidence limit: Boys</th>
<th>Upper 95% confidence limit: Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>125</td>
<td>121</td>
<td>129</td>
<td>233</td>
<td>228</td>
<td>239</td>
</tr>
<tr>
<td>5 to 9</td>
<td>74</td>
<td>71</td>
<td>77</td>
<td>116</td>
<td>112</td>
<td>120</td>
</tr>
<tr>
<td>10 to 14</td>
<td>31</td>
<td>29</td>
<td>33</td>
<td>39</td>
<td>37</td>
<td>41</td>
</tr>
<tr>
<td>15 to 19</td>
<td>19</td>
<td>18</td>
<td>21</td>
<td>14</td>
<td>13</td>
<td>16</td>
</tr>
</tbody>
</table>

**Note**
Results are based on the pooled 3-year average for the most recent years (2013–2014 to 2015–2016). Similar patterns were observed for pooled data from 2006–2007 to 2008–2009 (data not shown).

**Source**
Hospital Morbidity Database, Canadian Institute for Health Information.

**Figure 3** Asthma hospitalization (age 0 to 19) by sex, Canada, 2006–2007 to 2015–2016

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>116</td>
<td>93</td>
<td>94</td>
<td>80</td>
<td>74</td>
<td>64</td>
<td>66</td>
<td>56</td>
<td>68</td>
<td>57</td>
</tr>
<tr>
<td>Boys</td>
<td>190</td>
<td>159</td>
<td>153</td>
<td>134</td>
<td>119</td>
<td>105</td>
<td>105</td>
<td>89</td>
<td>108</td>
<td>92</td>
</tr>
<tr>
<td>Both boys and girls</td>
<td>154</td>
<td>127</td>
<td>124</td>
<td>108</td>
<td>97</td>
<td>85</td>
<td>86</td>
<td>73</td>
<td>88</td>
<td>75</td>
</tr>
</tbody>
</table>

**Source**
Hospital Morbidity Database, Canadian Institute for Health Information.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>358</td>
<td>353</td>
<td>363</td>
<td>180</td>
<td>177</td>
<td>184</td>
<td>50%</td>
</tr>
<tr>
<td>5 to 9</td>
<td>134</td>
<td>131</td>
<td>137</td>
<td>96</td>
<td>93</td>
<td>98</td>
<td>28%</td>
</tr>
<tr>
<td>10 to 14</td>
<td>48</td>
<td>46</td>
<td>49</td>
<td>35</td>
<td>33</td>
<td>36</td>
<td>27%</td>
</tr>
<tr>
<td>15 to 19</td>
<td>22</td>
<td>21</td>
<td>23</td>
<td>17</td>
<td>16</td>
<td>18</td>
<td>23%</td>
</tr>
</tbody>
</table>

Notes
The percentage decrease was calculated by subtracting the later age-standardized hospitalization rate per 100,000 population from the earlier rate, dividing by the earlier rate and multiplying by 100%. Results are based on the pooled 3-year average for the most recent years (2013–2014 to 2015–2016). Similar patterns were observed for pooled data from 2006–2007 to 2008–2009 (data not shown).

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
### Figure 5  Asthma hospitalization (age 0 to 19) by province/territory, 2006–2007 to 2008–2009 versus 2013–2014 to 2015–2016

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Newfoundland and Labrador</td>
<td>171</td>
<td>157</td>
<td>186</td>
<td>85</td>
<td>75</td>
<td>96</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>226</td>
<td>195</td>
<td>257</td>
<td>163</td>
<td>137</td>
<td>189</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>193</td>
<td>182</td>
<td>205</td>
<td>80</td>
<td>72</td>
<td>87</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>184</td>
<td>172</td>
<td>196</td>
<td>65</td>
<td>58</td>
<td>73</td>
</tr>
<tr>
<td>Quebec</td>
<td>172</td>
<td>168</td>
<td>175</td>
<td>66</td>
<td>64</td>
<td>68</td>
</tr>
<tr>
<td>Ontario</td>
<td>125</td>
<td>123</td>
<td>128</td>
<td>90</td>
<td>88</td>
<td>92</td>
</tr>
<tr>
<td>Manitoba</td>
<td>108</td>
<td>101</td>
<td>114</td>
<td>61</td>
<td>56</td>
<td>66</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>169</td>
<td>160</td>
<td>178</td>
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<td>103</td>
<td>117</td>
</tr>
<tr>
<td>Alberta</td>
<td>105</td>
<td>101</td>
<td>109</td>
<td>72</td>
<td>69</td>
<td>75</td>
</tr>
<tr>
<td>British Columbia</td>
<td>105</td>
<td>101</td>
<td>109</td>
<td>71</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>Yukon</td>
<td>96</td>
<td>57</td>
<td>135</td>
<td>30</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>Northwest Territories</td>
<td>153</td>
<td>115</td>
<td>191</td>
<td>121</td>
<td>86</td>
<td>157</td>
</tr>
<tr>
<td>Nunavut</td>
<td>83</td>
<td>56</td>
<td>111</td>
<td>78</td>
<td>53</td>
<td>103</td>
</tr>
<tr>
<td>Canada</td>
<td>135</td>
<td>134</td>
<td>137</td>
<td>79</td>
<td>78</td>
<td>80</td>
</tr>
</tbody>
</table>

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
### Figure 6  
Asthma hospitalization (age 0 to 19) by neighbourhood income, Canada, 2006–2007 to 2015–2016

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (lowest)</td>
<td>194</td>
<td>158</td>
<td>147</td>
<td>134</td>
<td>116</td>
<td>109</td>
<td>110</td>
<td>94</td>
<td>110</td>
<td>96</td>
</tr>
<tr>
<td>Q2</td>
<td>167</td>
<td>139</td>
<td>141</td>
<td>122</td>
<td>111</td>
<td>91</td>
<td>96</td>
<td>78</td>
<td>98</td>
<td>83</td>
</tr>
<tr>
<td>Q3</td>
<td>157</td>
<td>133</td>
<td>138</td>
<td>120</td>
<td>110</td>
<td>86</td>
<td>86</td>
<td>76</td>
<td>89</td>
<td>77</td>
</tr>
<tr>
<td>Q4</td>
<td>137</td>
<td>122</td>
<td>119</td>
<td>105</td>
<td>102</td>
<td>78</td>
<td>75</td>
<td>65</td>
<td>79</td>
<td>65</td>
</tr>
<tr>
<td>Q5 (highest)</td>
<td>126</td>
<td>98</td>
<td>104</td>
<td>88</td>
<td>81</td>
<td>68</td>
<td>69</td>
<td>57</td>
<td>73</td>
<td>59</td>
</tr>
</tbody>
</table>

**Note**  
Results are based on income defined at the neighbourhood level using Statistics Canada’s PCCF+ tool. See the Methodology section for more information.

**Source**  
Hospital Morbidity Database, Canadian Institute for Health Information.
Figure 7  Asthma hospitalization, by neighbourhood income and age group, Canada, 2013–2014 to 2015–2016

<table>
<thead>
<tr>
<th>Neighbourhood income quintile</th>
<th>Hospitalization rate per 100,000 population: Age 0 to 9</th>
<th>Lower 95% confidence limit: Age 0 to 9</th>
<th>Upper 95% confidence limit: Age 0 to 9</th>
<th>Hospitalization rate per 100,000 population: Age 10 to 19</th>
<th>Lower 95% confidence limit: Age 10 to 19</th>
<th>Upper 95% confidence limit: Age 10 to 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (lowest)</td>
<td>170</td>
<td>164</td>
<td>175</td>
<td>37</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Q2</td>
<td>151</td>
<td>145</td>
<td>156</td>
<td>29</td>
<td>27</td>
<td>31</td>
</tr>
<tr>
<td>Q3</td>
<td>143</td>
<td>138</td>
<td>148</td>
<td>25</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Q4</td>
<td>125</td>
<td>121</td>
<td>129</td>
<td>20</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Q5 (highest)</td>
<td>113</td>
<td>109</td>
<td>118</td>
<td>18</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

Note
Results are based on income defined at the neighbourhood level using Statistics Canada’s PCCF+ tool. See the Methodology section for more information.

Source
Hospital Morbidity Database, Canadian Institute for Health Information.

Figure 8  Geographic distribution of population (age 0 to 19), Canada, 2015–2016

In 2015–2016, 82% of the Canadian population age 0 to 19 lived in urban areas, and 18% lived in rural/remote areas.

Note
Geographic location was assigned based on Statistics Canada’s Statistical Area Classification type (SACtype): SACtypes 1, 2 and 3 are urban, and SACtypes 4, 5, 6, 7 and 8 are rural/remote. This variable takes into account population size and commuting to large urban centres.

Source
Asthma Hospitalizations Among Children and Youth in Canada: Trends and Inequalities

Figure 9  Asthma hospitalization (age 0 to 19), by urban versus rural/remote geographic location, provinces/territories, 2013–2014 to 2015–2016

<table>
<thead>
<tr>
<th>Province/territory</th>
<th>Hospitalization rate per 100,000 population: Urban</th>
<th>Lower 95% confidence limit: Urban</th>
<th>Upper 95% confidence limit: Urban</th>
<th>Hospitalization rate per 100,000 population: Rural/remote</th>
<th>Lower 95% confidence limit: Rural/remote</th>
<th>Upper 95% confidence limit: Rural/remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newfoundland and Labrador</td>
<td>81</td>
<td>67</td>
<td>94</td>
<td>90</td>
<td>75</td>
<td>106</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>139</td>
<td>108</td>
<td>170</td>
<td>199</td>
<td>153</td>
<td>245</td>
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<td>Nova Scotia</td>
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<td>79</td>
<td>98</td>
<td>61</td>
<td>49</td>
<td>72</td>
</tr>
<tr>
<td>New Brunswick</td>
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</tr>
<tr>
<td>Quebec</td>
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<td>Ontario</td>
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<td>75</td>
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<tr>
<td>Manitoba</td>
<td>60</td>
<td>54</td>
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<td>Saskatchewan</td>
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<td>Alberta</td>
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<td>62</td>
<td>75</td>
</tr>
<tr>
<td>British Columbia</td>
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<td>Northwest Territories</td>
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<td>79</td>
<td>81</td>
<td>71</td>
<td>69</td>
<td>74</td>
</tr>
</tbody>
</table>

Notes
Data for Yukon and Nunavut was suppressed due to small numbers.
Geographic location was assigned based on Statistics Canada’s Statistical Area Classification type (SACtype): SACtypes 1, 2 and 3 are urban, and SACtypes 4, 5, 6, 7 and 8 are rural/remote. This variable takes into account population size and commuting to large urban centres. 43

Source
Hospital Morbidity Database, Canadian Institute for Health Information.
In 2006, the highest level of household educational attainment among Canadian households with children and youth age 0 to 19 was as follows:

- Less than high school: 7%
- High school completion: 28%
- Post-secondary school completion below a bachelor’s degree: 33%
- Bachelor’s degree completion: 19%
- Post-secondary school completion above a bachelor’s degree: 13%

**Note**
Distribution is based on the Canadian population (excluding Quebec) age 0 to 19, estimated using the weighted long-form census.

**Source**
**Figure 11** Asthma hospitalization (age 0 to 19), by household educational attainment and sex, Canada (excluding Quebec), 2006–2007 to 2008–2009

<table>
<thead>
<tr>
<th>Highest household educational attainment</th>
<th>Hospitalization rate per 100,000 population: Girls</th>
<th>Lower 95% confidence limit: Girls</th>
<th>Upper 95% confidence limit: Girls</th>
<th>Hospitalization rate per 100,000 population: Boys</th>
<th>Lower 95% confidence limit: Boys</th>
<th>Upper 95% confidence limit: Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than high school</td>
<td>89</td>
<td>71</td>
<td>111</td>
<td>182</td>
<td>154</td>
<td>215</td>
</tr>
<tr>
<td>High school</td>
<td>88</td>
<td>79</td>
<td>99</td>
<td>150</td>
<td>137</td>
<td>165</td>
</tr>
<tr>
<td>Post-secondary school below bachelor’s degree</td>
<td>73</td>
<td>66</td>
<td>82</td>
<td>127</td>
<td>116</td>
<td>139</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>71</td>
<td>62</td>
<td>81</td>
<td>111</td>
<td>99</td>
<td>124</td>
</tr>
<tr>
<td>Above bachelor’s degree</td>
<td>48</td>
<td>39</td>
<td>58</td>
<td>71</td>
<td>60</td>
<td>83</td>
</tr>
</tbody>
</table>

*Source*

Figure 12  Asthma hospitalization (age 0 to 19), by household educational attainment and age group, Canada (excluding Quebec), 2006–2007 to 2008–2009

<table>
<thead>
<tr>
<th>Highest household educational attainment</th>
<th>Hospitalization rate per 100,000 population: Age 0 to 9</th>
<th>Lower 95% confidence limit: Age 0 to 9</th>
<th>Upper 95% confidence limit: Age 0 to 9</th>
<th>Hospitalization rate per 100,000 population: Age 10 to 19</th>
<th>Lower 95% confidence limit: Age 10 to 19</th>
<th>Upper 95% confidence limit: Age 10 to 19</th>
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</thead>
<tbody>
<tr>
<td>Less than high school</td>
<td>230</td>
<td>196</td>
<td>269</td>
<td>52</td>
<td>41</td>
<td>66</td>
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<tr>
<td>High school</td>
<td>221</td>
<td>204</td>
<td>239</td>
<td>30</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>Post-secondary school below bachelor’s degree</td>
<td>187</td>
<td>174</td>
<td>202</td>
<td>24</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>171</td>
<td>156</td>
<td>188</td>
<td>20</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Above bachelor’s degree</td>
<td>111</td>
<td>97</td>
<td>127</td>
<td>14</td>
<td>10</td>
<td>20</td>
</tr>
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Source
References


10. Fouzas S, Brand PLP. *Predicting persistence of asthma in preschool wheezers: Crystal balls or muddy waters?*. *Paediatric Respiratory Reviews*. 2013.


56. Kelso JM. *Do written asthma action plans improve outcomes?*. Pediatric Allergy, Immunology, and Pulmonology. 2016.

57. Harrington KF, Zhang B, Magruder T, Bailey WC, Gerald LB. *The impact of parent’s health literacy on pediatric asthma outcomes*. Pediatric Allergy, Immunology, and Pulmonology. 2015.


64. National Collaborating Centre for Healthy Public Policy. *Thirteen Public Interventions in Canada That Have Contributed to a Reduction in Health Inequalities*. 2010.


<table>
<thead>
<tr>
<th>Location</th>
<th>Address</th>
<th>Suite</th>
<th>City, Province</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIHI Ottawa</td>
<td>495 Richmond Road</td>
<td>600</td>
<td>Ottawa, Ont.</td>
<td>613-241-7860</td>
</tr>
<tr>
<td>CIHI Toronto</td>
<td>4110 Yonge Street</td>
<td>300</td>
<td>Toronto, Ont.</td>
<td>416-481-2002</td>
</tr>
<tr>
<td>CIHI Victoria</td>
<td>880 Douglas Street</td>
<td>600</td>
<td>Victoria, B.C.</td>
<td>250-220-4100</td>
</tr>
<tr>
<td>CIHI Montréal</td>
<td>1010 Sherbrooke Street West</td>
<td>602</td>
<td>Montréal, Que.</td>
<td>514-842-2226</td>
</tr>
</tbody>
</table>