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Asthma is one of the most common chronic conditions in childhood, and its prevalence is increasing in many countries, including Canada.¹⁻⁴ This article picks up where previous examinations of childhood asthma have left off.^{4,5} Based on data from the National Longitudinal Survey of Children and Youth (NLSCY), changes in prevalence rates among children aged 0 through 11 are examined from 1994/1995 through 2000/2001, by asthma severity, and by child and family socio-demographic factors.

Prevalence increasing

In 1994/1995, 11% of Canadian children aged 0 to 11 (nearly 520,000) had been diagnosed with asthma.

Table 1

Asthma prevalence among children aged 0 to 11, Canada excluding territories, 1994/1995 to 2000/2001

	1994/ 1995	1996/ 1997	1998/ 1999	2000/ 2001	Comparison between 1994/1995 and 2000/2001 (p-value)
Population aged 0 to 11 (000s)	4,681.2	4,750.0	4,514.9	4,379.6	...
Number with asthma (000s)	518.4	575.4	583.7	586.0	...
% with asthma	11.1	12.1	12.9	13.4	<.0001
Asthma severity among children with asthma					
Low (%)	27.0	29.0	31.8	30.9	ns
Moderate (%)	32.3	31.3	32.0	33.3	ns
High (%)	40.8	39.7	36.2	35.8	.02
Asthma attack in past year among children with asthma					
Number (000s)	264.4	256.6	241.3	230.2	...
%	51.1	44.6	41.4	39.3	<.0001
Wheezing in past year					
% of 0- to 11-year-olds	17.5	17.2	18.5	18.7	ns
% of 0- to 11-year-olds with asthma	66.5	65.2	62.2	60.5	.007
Regular use of inhalants					
% of children with asthma	47.2	45.6	42.2	44.5	ns

ns = not significant
 ... not applicable
Note: Because of rounding, detail may not add to 100%.
Source: 1994/1995 to 2000/2001 National Longitudinal Survey of Children and Youth.

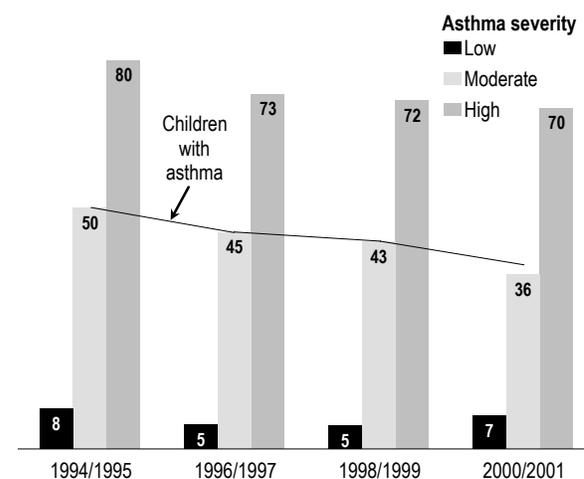
By 2000/2001, the rate had risen to more than 13% (Table 1), a statistically significant increase of nearly 70,000 children.

Among children with asthma, the proportion with high-severity symptoms dropped from 41% in 1994/1995 to 36% in 2000/2001. This is similar to a British study that found a significant increase in the prevalence of asthma diagnosis, but only for children with mild symptoms.⁶

Asthma attacks less common

Despite the increase in childhood asthma, the prevalence of asthma attacks decreased. In 1994/1995, about half (51%) of 0- to 11-year-olds with asthma were reported to have had an attack in the previous year; by 2000/2001, this proportion had dropped to 39% (Table 1).

Figure 1
 Prevalence of past-year asthma attacks among children aged 0 to 11 with asthma, by asthma severity, Canada excluding territories, 1994/1995 to 2000/2001



Source: 1994/1995 to 2000/2001 National Longitudinal Survey of Children and Youth.

Throughout the period, the likelihood of having had an asthma attack depended on the severity of the disease (Figure 1). For example, in 2000/2001, 70% of children with high-severity asthma were reported to have had an attack in the past year, compared with fewer than 10% of those with low-severity asthma.

Treatment and use of inhalers

The decrease in asthma attacks among Canadian children may be associated with the use of medications. Two types of treatment are available: relievers and controllers (Table 2). Both types of treatment are generally administered through inhalation devices, sometimes called inhalers or puffers, although oral medication is also available.

Relievers (short-acting β_2 -agonists) are used on demand when a child becomes symptomatic. This may be during periods of physical exertion or when the condition is triggered by environmental stimuli such as pets, dust or tobacco smoke. For children with mild asthma requiring infrequent treatment, relievers are recommended.⁷⁻⁹ More severe cases are generally treated with controllers, that is, inhaled

glucocorticoids,⁷⁻⁹ which are typically used daily to help control asthma and prevent attacks.¹⁰ It was not possible to differentiate the use of these two types of medication in the NLSCY, as the question asked only if the child used inhalers or puffers for asthma, not if the medication was for relief or control of the condition.

Nearly 45% of children with asthma used inhalers on a regular basis in 2000/2001, a figure similar to that reported in 1994/1995 (Table 1). However, the use of inhalers (as asked in the NLSCY) is not the same as reporting whether a child has been prescribed an inhaler. A child may have a prescribed inhaler, but owing to better control of asthma or lower severity, may not have to use it regularly. This is particularly true for asthma relievers. In such cases, the person reporting on behalf of the child is likely to have answered “no” to questions about regular inhaler use, even though the child has a prescription for inhaled asthma medications. Therefore, it is possible that the prevalence of prescriptions is underestimated in this sample. Another possibility is that other asthma controllers or adjunct treatments may have been used, but were not captured by any of the NLSCY items.

Table 2

Asthma treatments and their use

Treatment	Examples	Use
Relievers	Inhaled short-acting β_2 -agonist (bronchodilators)	As needed to relieve intermittent asthma symptoms; not to exceed 3 times/week
Controllers	Inhaled or oral glucocorticosteroid (e.g., beclomethasone dipropionate, budesonide, fluticasone propionate)	Daily; lowest dosage necessary to achieve control of symptoms
Adjunct therapy	Leukotriene-receptor agonists	May be used as alternative to higher doses of inhaled glucocorticosteroids or for those who are intolerant to glucocorticosteroids
	Anti-allergic, non-steroidal agents (e.g., cromoglycate, nedocromil)	May be used in children as alternative to low-dose inhaled glucocorticosteroids
	Long-acting β_2 -agonists (e.g., salmeterol, formoterol, theophylline, ipratropium)	In addition to inhaled glucocorticosteroids, may be used as alternative to higher doses to achieve control

Source: Canadian Asthma Consensus Report, 1999.⁸

Boys and older children

Boys were significantly more likely than girls to have been diagnosed with asthma (Table 3). For example, in 2000/2001, 16% of boys were reported to have asthma, compared with around 11% of girls, a difference that has been observed in other studies.¹¹⁻¹³ Boys were also more likely than girls to have had symptoms such as wheezing or whistling in the chest (Table 4). However, among children with asthma, there was no gender difference in the rate of attacks in the past year (Table 4).

The prevalence of asthma among boys rose significantly from just under 14% to 16% between 1994/1995 and 2000/2001 (Table 3). However, the percentage of boys with asthma who had had an attack in the past year fell from 52% to 41% (Table 4). The pattern was similar for girls, but unlike boys, the percentage who had experienced wheezing or whistling in the chest increased (Table 4).

Table 3
Prevalence of asthma among children aged 0 to 11, by selected characteristics, Canada excluding territories, 1994/1995 to 2000/2001

	Prevalence of asthma				Comparison between 1994/1995 and 2000/2001 (p-value)
	1994/1995	1996/1997	1998/1999	2000/2001	
	%				
Total	11.1	12.1	12.9	13.4	<.0001
Sex					
Male	13.6*	14.9*	15.3*	16.1*	.002
Female†	8.4	9.2	10.4	10.5	.003
Age					
0 to 5	8.4‡	8.9‡	9.9‡	9.9‡	.003
6 to 9	13.7	15.2	15.0	15.7	ns
10 to 11	14.0	15.4	17.6	17.6	.03
Daily smoker in household					
Yes	13.0*	13.4*	14.8*	15.4*	.01
No†	9.8	11.4	12.0	12.5	.0001
Household income					
Lowest/Lower-middle	11.9	14.2*	15.3*	15.5	.04
Middle	10.8	11.0	12.5	12.2	ns
Upper-middle	10.8	13.1*	13.1	14.5	.0002
Highest†	11.2	10.0	11.9	12.4	ns
Urban/Rural					
Urban	11.2	12.3*	12.9	13.5	.0002
Rural†	10.5	10.5	12.9	12.8	.03
Region of residence					
British Columbia†	9.6	10.3	10.8	11.4	ns
Prairie provinces	10.1	10.7	11.1	11.1	ns
Ontario	11.1	13.3*	13.8*	13.6	.01
Quebec	11.3	10.9	13.3	15.1*	.002
Atlantic provinces	14.7*	16.2*	15.8*	15.5*	ns

† reference category
‡ significantly different from estimate for next-oldest age group (p < 0.05)
* significantly different from estimate for reference category (p < 0.05)
ns = no statistically significant difference between 1994/1995 and 2000/2001
Source: 1994/1995 to 2000/2001 National Longitudinal Survey of Children and Youth.

Young children were less likely than older children to have been diagnosed with asthma (Table 3). Throughout the period, the proportion of 6- to 9-year-olds who had asthma was significantly higher than the proportion of 0- to 5-year-olds.

Although the prevalence of asthma rose in all age groups between 1994/1995 and 2000/2001, the increase was significant only for 0- to 5-year-olds and 10- to 11-year-olds (Table 3). The prevalence of wheezing or whistling in the chest also increased among the youngest children (Table 4).

Relatively lower rates of asthma but higher rates of wheezing or whistling in the chest among 0- to 5-year-olds are not contradictory. Health professionals often have difficulty diagnosing asthma in very young children, who are less able to follow instructions required to complete the diagnostic lung function test. Young children (ages 0 to 5 who experience wheezing and whistling in the chest may go to be diagnosed with asthma when they are older. Conversely, asthma symptoms may resolve as the child's airways grow and develop.

Table 4
Prevalence of wheezing or whistling in chest in past year (all children aged 0 to 11) and asthma attack (children aged 0 to 11 with asthma), by selected characteristics, 1994/1995 and 2000/2001

	Prevalence of past-year wheezing or whistling in chest (all children)		Prevalence of past-year asthma attack (children with asthma)	
	1994/1995	2000/2001	1994/1995	2000/2001
	%		%	
Total	17.5	18.7	51.1	39.3 [§]
Sex				
Male	20.1*	20.5*	52.0	40.9 [§]
Female†	14.7	16.8 [§]	49.5	36.7 [§]
Age				
0 to 5	19.4‡	22.1 ^{‡§}	56.8‡	48.3 ^{‡§}
6 to 9	16.7‡	16.4	48.6	33.7 [§]
10 to 11	13.5	14.5	45.6	36.8
Daily smoker in household				
Yes	20.2*	20.9*	49.8	41.0 [§]
No†	15.8	17.7 [§]	52.4	38.7 [§]
Household income				
Lowest/Lower-middle	20.4*	21.2*	52.0	41.3
Middle	16.6	17.9	52.6	32.7 [§]
Upper-middle	17.5	20.2* [§]	50.9	43.5
Highest†	15.8	16.6	47.2	38.8
Urban/Rural				
Urban	17.7	18.7	52.3*	39.6 [§]
Rural†	16.4	18.7 [§]	45.2	36.8
Region of residence				
British Columbia†	15.3	14.4	52.8	43.8
Prairie provinces	16.2	16.6	52.0	44.8
Ontario	17.3	19.4*	49.9	35.6 [§]
Quebec	18.7*	20.5*	51.2	39.1 [§]
Atlantic provinces	21.3*	21.7*	51.7	42.4 [§]

† reference category
‡ significantly different from estimate for next-oldest age group (p < 0.05)
* significantly different from estimate for reference category (p < 0.05)
§ significant difference between 1994/1995 and 2000/2001 (p < 0.05)
Source: 1994/1995 to 2000/2001 National Longitudinal Survey of Children and Youth.

Among children who had been diagnosed with asthma, past-year attacks dropped significantly for those aged 0 to 5 and 6 to 9 (Table 4).

Smoking in household increases risk

Children living in households where either parent was a daily smoker were significantly more likely than children in non-smoking households to have been diagnosed with asthma (Table 3) or to have asthma-like symptoms (Table 4). However, among children with asthma, there was no difference in the rate of past-year asthma attacks between those in smoking and non-smoking households (Table 4).

Between 1994/1995 and 2000/2001, in smoking households, the prevalence of asthma among children increased (Table 3), but past-year attacks among those with asthma decreased (Table 4). Curiously, only children in non-smoking households experienced an increase in the prevalence of wheezing or whistling in the chest (Table 4). The presence of other allergenic factors in the home (pets, for instance), which was not assessed in the NLSCY, may be related to the increase in asthma-like symptoms among children in non-smoking households.

Association with income

While low income generally tends to be associated with poor health, and high income with good health, the relationship between household income and childhood asthma did not follow this pattern. In 2000/2001, the prevalence of childhood asthma did not differ significantly by household income (Table 3). Similarly, among those with asthma, the likelihood of having had an attack in the past year was not related to household income (Table 4). And while reports of wheezing or whistling in the chest were significantly high for children in lowest/lower-middle income households, this was also true for those in upper-middle income households.

From 1994/1995 to 2000/2001, the prevalence of asthma rose significantly for children in the lowest/lower-middle and upper-middle income

households (Table 3). Rates of wheezing and whistling in the chest increased among children in the upper-middle income group (Table 4). Yet for children with asthma, the rate of past-year attacks fell among those in middle income households.

Regional differences

As has been found in other Canadian studies,¹⁴ the prevalence of asthma among children did not differ between urban and rural areas. By contrast, surveys in other countries, notably the United States, have found significantly higher rates of childhood asthma in urban centres, where pollution tends to be higher and air quality poorer.¹⁵

However, childhood asthma rates in Canada did differ by region. Children in British Columbia and the prairie provinces (Alberta, Saskatchewan and Manitoba) had the lowest rates in every NLSCY cycle. In the other regions, rates were significantly higher, particularly in the Atlantic provinces (Nova Scotia, Newfoundland, New Brunswick and Prince Edward Island).

Other researchers who have found the same regional patterns attempted to determine if the differences in childhood asthma rates could be explained by environmental conditions such as ozone, temperature, and relative humidity.⁵ But even when these factors were taken into account, children in the Atlantic provinces continued to show higher rates of asthma. Other factors that may be associated with these regional discrepancies could be indoor air conditions, acid aerosol levels, and even early immigration and settlement practices that may have contributed to a greater genetic predisposition to asthma in the Atlantic provinces.⁵

Summary

The prevalence of childhood asthma is rising, particularly among boys, among 0- to 5-year-olds and 10- to 11-year-olds, and among children in households where adults smoke. Whether the increase is due to an improvement in physicians' ability to recognize and diagnose asthma, or whether

About the data

The data for this article are from the National Longitudinal Survey of Children and Youth (NLSCY), a longitudinal survey that has been conducted biennially since 1994/1995. The target population was children who were aged 0 to 11 in 1994/1995. Beginning in 1996/1997, an additional cohort (primarily newborns and one-year-olds) was recruited to each cycle to maintain a representative sample of children aged 0 through 11.

For every household, the “person most knowledgeable” (PMK) about the child was identified to provide information about each respondent child, as well as for the entire household. In most cases, the PMK was the child’s biological mother.

Data from the first four NLSCY cycles were used for this article. Cross-sectional weights were not made available in the NLSCY for the fifth and sixth cycles, which precluded their use in this analysis. Estimates were weighted to represent the Canadian population aged 0 through 11 on January 1 of each survey year. Analyses were bootstrapped to account for the complex survey design.

The prevalence of asthma among children was based on the PMK’s response to the question: “Has he/she ever had asthma that was diagnosed by a health professional?” If they answered “yes,” PMKs were asked if their child had had an asthma attack in the past 12 months. All PMKs, regardless of whether the child had been diagnosed with asthma, were asked: “Has he/she had wheezing or whistling in the chest at any time in the last 12 months?” and “Does he/she take any of the following prescribed medication on a regular basis: Ventolin or other inhalants?”

The NLSCY does not ask about the severity of a child’s asthma per se. To obtain a proxy for asthma severity, two items were used to create a classification: past-year wheezing or whistling in the chest and regular use of inhalers. Three levels of severity in children with asthma were identified:

- Low: no wheezing or whistling in the chest in the past year and no regular use of inhalers.
- Moderate: wheezing or whistling in the chest in the past year OR regular use of inhalers.
- High: wheezing or whistling in the chest in the past year AND regular use of inhalers.

While this classification is based on measures used in other epidemiological studies,¹⁶ as an indicator of severity, it is only a proxy

and is limited in its ability to generate classes that are homogenous in the individuals they capture. Nevertheless, in other studies,¹⁷ this measure has been associated with poor health and the presence of activity limitations.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 to 4	Less than \$10,000
	5 or more	Less than \$15,000
Lower-middle	1 or 2	\$10,000 to \$14,999
	3 or 4	\$10,000 to \$19,999
	5 or more	\$15,000 to \$29,999
Middle	1 or 2	\$15,000 to \$29,999
	3 or 4	\$20,000 to \$39,999
	5 or more	\$30,000 to \$59,999
Upper-middle	1 or 2	\$30,000 to \$59,999
	3 or 4	\$40,000 to \$79,999
	5 or more	\$60,000 to \$79,999
Highest	1 or 2	\$60,000 or more
	3 or more	\$80,000 or more

For this analysis, the two lowest income groups were combined.

The use of survey data entails certain limitations. First, the analysis is constrained by the items and wording in the survey. For example, as noted above, because no single question about asthma severity was included in the NLSCY, a composite measure was derived from existing items. For this analysis, it would also have been preferable to have more detailed questions about the use of asthma medications, including type (reliever versus controller), use of adjunct therapy, and the frequency of treatment use.

Second, it was not possible to use NLSCY data post-2000/2001, because cross-sectional survey weights were not generated for more recent cycles. Nevertheless, these results update⁴ information about the prevalence of childhood asthma and provide a description of trends by sociodemographic and behavioural factors.

A final limitation of this study is the inability to determine if the increase in the prevalence of asthma was due to changes in diagnostic behaviors, in patterns of prescribing medications, in behavioural symptoms, or in the prevalence of the condition itself.

the underlying causes are becoming more widespread, cannot be determined from this analysis and warrant further study.

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