Prevalence and risk factors of asthma in First Nations children living on reserves in Canada

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ABSTRACT

OBJECTIVES: To explore the prevalence and determine the risk factors of asthma in First Nations children aged 0 to 11 years living on reserves in Canada.

METHODS: In this cross-sectional study, we considered the data collected as part of the First Nations Regional Health Survey involving 6,657 children living in 238 First Nations communities in the 10 Canadian provinces, the Northwest Territories and the Yukon.

RESULTS: The overall prevalence of asthma that has lasted or is expected to last at least six months (ever-asthma) among children living on reserves was 14.6%: a prevalence of 12.9% among 0 to 4 year olds and 15.6% among 5 to 11 year olds. The prevalence of ever-asthma was greater among boys (16.1%) than girls (13.2%). Children from homes with two or more children aged less than 11 years and those who were engaged in daily physical activities were less likely to have a report of ever-asthma. Children from high-income families and smoke-free homes were more likely to have a report of ever-asthma. The association between allergy and ever-asthma was stronger in children with low birth weight. The association between chronic ear infections and ever-asthma was stronger in girls than boys.

CONCLUSIONS: The overall prevalence of ever-asthma and factors associated with ever-asthma in First Nations children living on reserves were similar to those reported for off-reserve Aboriginal children and non-Aboriginal Canadian children.

KEY WORDS: Asthma; children; First Nations; prevalence; risk factors

La traduction du résumé se trouve à la fin de l'article.

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Asthma is a common childhood chronic disease in the world. Demographic, lifestyle, genetic and environmental factors are known to be associated with asthma incidence, prevalence and severity.¹ In Canada, the Aboriginal community is composed of three groups: First Nations, Métis and Inuit peoples. First Nations and Métis peoples are primarily Ojibwa and are not culturally different. From a secondary analysis of the 2006 Aboriginal Children's Survey, the prevalence of asthma among off-reserve Aboriginal children was reported to be 9.4% in 0 to 6 year olds and 14.3% in 6 to 14 year olds.^{2,3} For children aged 0 to 11 years living in Canadian northern territories, the prevalence of asthma was lower among Aboriginal children (5.7%) than non-Aboriginal children (10.0%).⁴ In off-reserve Aboriginal children aged 0 to 6 years, low birth weight, male sex, exclusive breast feeding, two or more older siblings, daycare attendance and ear infection were significantly associated with ever-asthma (asthma that has lasted or is expected to last at least six months).⁵ In off-reserve Aboriginal children aged 6 to 11 years, male sex, allergy, low birth weight, obesity, poor dwelling conditions and urban residence were significantly associated with ever-asthma.² A US study examined the prevalence of asthma among children aged 0 to 17 years using the data from the National Health Interview Survey and reported that the current asthma prevalence was greater among American Indian/Alaska Native children (9.9%) than among

White children (7.9%) in 2004–2005.⁵ The chronic morbidity associated with asthma, including hospitalizations and poorer clinical outcomes, has been reported to be greater in the Indigenous children compared with their non-Indigenous counterparts in Australia, Canada, New Zealand and the US.^{5,6}

In an initial report of the First Nations Regional Health Survey (RHS Phase 1) conducted in 2002–2003, the overall prevalence of asthma attacks and ever-asthma among First Nations children was briefly described, and asthma was reported as a common chronic condition among First Nations children aged 0 to 11 years.^{7,8} In this cross-sectional study, we used the data from the RHS Phase 1 to examine the age-/sex-specific prevalence of

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ever-asthma and factors associated with it among First Nations children living on reserves in Canada.⁷

METHODS

Aboriginal population

Aboriginal people in Canada comprise First Nations, Métis and Inuit populations. In the 2011 Canadian Census, 4.3% (1,400,685) of the Canadian population were of Aboriginal descent: 851,560 First Nations, 451,795 Métis, 59,445 Inuit, 26,475 other Aboriginal identities and 11,415 mixed Aboriginal identities.⁹ The majority of the First Nations people belong to over 600 bands; these people are spread across Canada and live mainly on reserves that are governed by local bands. In addition, First Nations people who have signed the treaty agreement under the *Indian Act* with the federal government are referred to as “Registered Indians”. Of the 851,560 First Nations people, 637,660 (74.9%) were Registered Indians, 49.3% of whom lived on reserves; the rest lived in urban areas.⁹

Data source

The data from the first phase of the RHS, conducted in 2002–03, were used in this cross-sectional study.⁷ Although the survey was initially planned as a longitudinal survey, respondents of RHS Phase 1 were not followed in the subsequent survey (RHS Phase 2), conducted in 2008–2010.¹⁰ In total, 607 of the 624 First Nation communities from 52 “subregions” in the 10 First Nations regions (all provinces and territories except Nunavut) initially agreed to participate in the survey. A stratified two-stage sampling design was used within each subregion. Communities were classified as small (<300), medium (300 to 1,499) and large (1,500 or greater), and initially all large communities were invited to participate. Within each subregion, representative numbers of small- and medium-sized communities were chosen in addition to the large communities. Of the 607 communities that initially agreed to participate, 238 finally participated in the survey. Community/band membership lists were obtained from each chosen community and divided into eight age/sex groups; participants in the survey were chosen randomly from the list in each community. In total, 10,962 adults (18 years and over), 4,983 youth (12 to 18 years) and 6,657 children (0 to 11 years) participated in the RHS.⁷ In this study, the data obtained from the child survey were considered. A person who knew the child well, generally the mother (81.7%), father (12.5%) or grandmother (3.1%), completed the child survey at the respondent’s home.

Asthma outcome and independent factors

The presence of ever-asthma in children was determined from the responses to the following question: “Have you been told by a health care professional that your child has any of the following health conditions? (Only include conditions that have lasted at least 6 months or are expected to last at least 6 months).” The information on asthma attacks was determined from the question “Has your child had an attack in the last 12 months?” The factors considered to be associated with ever-asthma were based on previous research and included prenatal/postnatal factors (e.g., smoking during pregnancy, birth weight, breastfeeding); demographic factors (e.g., age, sex, height, weight, community remoteness); early childhood factors (e.g., allergy,

daycare attendance, chronic ear infection); lifestyle factors (e.g., schooling, physical activity); and household factors (e.g., family income, number of children younger than 11 years and 11 to 17 years, smoke-free home). Family income, indicating the total household income, was categorized into low (<\$30,000), middle (\$30,000 to <\$60,000) and high (≥\$60,000) income groups. Birth weight was categorized into low (<2500 g) and normal (≥2500 g) birth weight groups. The World Health Organization (WHO) growth standards for birth to <5 years and WHO growth reference for 5 to 12 years were used to group the children into normal, underweight, overweight and obesity categories based on age and body mass index.^{11,12} A description of other independent variables can be found in the RHS questionnaire.⁷ The study was approved by the University of Alberta Health Research Ethics Board.

Statistical analysis

The design weight provided for the child survey was incorporated into the estimation of the age-/sex-specific prevalence of asthma attacks and ever-asthma and in all the statistical analyses. Logistic regression analysis was used to estimate the association between ever-asthma and independent factors, and the strength of the association was described using odds ratios and 95% confidence intervals. A purposeful selection method was adopted in logistic regression model building. Those factors with *p* values of less than 0.20 in the univariate logistic regression models were considered initially in the multiple logistic regression models, and only those factors that were clinically important and statistically significant (*p* < 0.05) were retained in the final multiple logistic regression model. Variables that were excluded from the model were not tested for confounding of the variables that were retained in the model. Clinically plausible interaction effects between the factors in the final logistic regression model were examined.

RESULTS

The overall prevalence of ever-asthma among First Nations children was 14.6%: 12.9% in 0 to 4 year olds and 15.6% in 5 to 11 year olds. The prevalence of ever-asthma was greater among boys (16.1%) than among girls (13.2%). Of those with ever-asthma, 27.1% had had asthma attacks in the previous 12 months.

As shown in Table 1, the proportion of children with asthma was significantly greater among those with a) a low birth weight; b) reported allergy and chronic ear infections; and c) a history of breastfeeding. Children who were attending daycare or school were significantly more likely to have a report of ever-asthma than those who were not attending. Children engaged in physical activity 2–3 times a week and children from families with high income were significantly more likely to have a report of ever-asthma. Children from households with 3 or more children aged less than 11 years were significantly less likely to have a report of ever-asthma, whereas children from households with 1 to 2 children aged 11 to 17 years were significantly more likely to have a report of ever-asthma. Children from remote-isolated and semi-isolated communities were less likely to have a report of ever-asthma than children from non-isolated communities with the differences being statistically non-significant.

Table 1. Proportion of ever-asthma by independent factor among First Nations children living on reserves*

Characteristic	Ever-asthma n (%)	Odds ratio (95% confidence interval)	p value
Age group (years)			0.20
0–4	243 (12.9)	1.0	
5–11	592 (15.6)	1.25 (0.89–1.75)	
Sex			0.14
Male	499 (16.1)	1.0	
Female	336 (13.2)	0.79 (0.58–1.08)	
Breastfed			0.003
No	343 (12.1)	1.0	
Yes	484 (16.7)	1.45 (1.23–1.85)	
Maternal smoking status			0.78
Not at all	410 (15.6)	1.0	
Throughout pregnancy	282 (14.7)	0.93 (0.67–1.28)	
Quit in 1 st trimester	60 (12.2)	0.75 (0.47–1.20)	
Quit in 2 nd trimester	37 (15.4)	0.99 (0.53–1.85)	
Quit in 3 rd trimester	17 (13.6)	0.85 (0.50–1.46)	
Birth weight			<0.001
Normal	703 (14.3)	1.0	
Low	58 (32.2)	2.84 (1.61–5.03)	
Allergy			<0.001
No	574 (10.2)	1.00	
Yes	230 (42.8)	6.55 (4.67–9.20)	
Chronic ear infections			0.006
No	707 (14.0)	1.00	
Yes	119 (19.6)	1.50 (1.12–2.00)	
Body mass index			0.22
Normal & underweight	127 (21.1)	1.0	
Overweight	115 (15.6)	0.69 (0.45–1.05)	
Obesity	136 (16.3)	0.73 (0.43–1.25)	
Attending daycare or school			<0.001
No	129 (9.8)	1.0	
Yes	704 (16.2)	1.78 (1.27–2.49)	
Physical activity			<0.001
Never	79 (13.4)	1.0	
≤1 time per week	104 (14.7)	1.12 (0.70–1.78)	
2–3 times per week	221 (20.3)	1.65 (1.14–2.38)	
4–6 times per week	106 (15.9)	1.23 (0.64–2.35)	
Every day	297 (11.5)	0.84 (0.55–1.29)	
No. of children <11 years of age			0.005
1 or fewer	223 (18.4)	1.0	
2 to 3	463 (14.3)	0.74 (0.59–0.91)	
4 and more	147 (12.1)	0.61 (0.39–0.97)	
No. of children 11 to 17 years of age			0.006
None	491 (13.2)	1.0	
1 to 2	312 (17.7)	1.42 (1.08–1.86)	
3 and more	30 (9.4)	0.68 (0.42–1.12)	
Family income			0.02
Low	405 (13.7)	1.0	
Middle	164 (15.6)	1.17 (0.72–1.89)	
High	56 (20.4)	1.61 (1.15–2.25)	
Smoke-free home			0.06
No	306 (13.2)	1.0	
Yes	523 (15.9)	1.24 (0.99–1.56)	
Remoteness of community			0.004
Remote-isolated	89 (13.0)	1.0	
Semi-isolated	51 (8.6)	0.63 (0.31–1.30)	
Non-isolated	639 (15.7)	1.25 (0.68–2.30)	

* Odds ratios and *p* values were obtained from univariate logistic regression.**Table 2.** Factors associated with ever-asthma in the multiple logistic regression

Variable	Odds ratio (95% confidence interval)	p value
Age group (years)		0.43
0–4	1.0	
5–11	1.14 (0.81–1.61)	
Sex*		<0.001
Male	1.0	
Female	0.55 (0.42–0.72)	
Allergy†		<0.001
No	1.0	
Yes	33.80 (9.03–126.57)	
Birth weight‡		0.036
Normal	1.0	
Low	1.68 (1.03–2.74)	
Chronic ear infections§		0.40
No	1.0	
Yes	0.79 (0.45–1.38)	
Attending daycare or school		0.064
No	1.0	
Yes	1.42 (0.98–2.07)	
Physical activity		0.001
Never	1.0	
≤1 time per week	1.17 (0.68–1.99)	
2–3 times per week	1.13 (0.73–1.76)	
4–6 times per week	0.76 (0.45–1.31)	
Every day	0.65 (0.42–0.99)	
No. of children <11 years of age		0.05
1 or fewer	1.0	
2 to 3	0.75 (0.56–1.02)	
4 and more	0.64 (0.43–0.93)	
No. of children 11 to 17 years of age		0.029
None	1.0	
1 to 2	1.38 (1.03–1.85)	
3 and above	0.59 (0.29–1.22)	
Family income		0.028
Low	1.0	
Middle	0.84 (0.61–1.16)	
High	1.61 (1.06–2.46)	
Smoke-free home		0.042
No	1.0	
Yes	1.28 (1.00–1.64)	
Remoteness of community		0.005
Remote-isolated / isolated	1.0	
Semi-isolated	0.59 (0.32–1.11)	
Non-isolated	1.31 (0.86–2.01)	
Allergy by birth weight		0.005
No allergy & normal birth weight	1.0	
Allergy & low birth weight	6.36 (1.75–23.07)	
Chronic ear infections by sex		<0.001
No ear infection & male	1.0	
Ear infection & female	4.80 (2.38–9.65)	

* Absence of chronic ear infection.

† For normal birth weight.

‡ Absence of allergy.

§ For male children.

from families with high income were more likely to have received a diagnosis of asthma. Significant interactions were observed between allergy and birth weight, and sex and chronic ear infection in the association with ever-asthma. The association between allergy and ever-asthma was stronger in children with low birth weight than in those with normal birth weight. The association between chronic ear infection and ever-asthma was stronger in girls than in boys.

DISCUSSION

In this cross-sectional study, the overall prevalence of ever-asthma among First Nations children aged 0 to 11 years was 14.6%, 27.1% of these children reporting that they had had an asthma attack in the previous 12 months. Boys showed a greater prevalence of

Results from the multiple logistic regression analysis are shown in Table 2. Children from households with 2 to 3, and 4 or more children under the age of 11 years were less likely to have a report of ever-asthma than children from the households with 1 child or fewer. However, this relationship was slightly reversed for children from households with 1 or 2 children aged 11 to 17 years. Children who were engaged in daily physical activity were less likely to have received a diagnosis of asthma. Those

ever-asthma than girls. In the RHS Phase 2 conducted in 2008–2010, the prevalence of ever-asthma declined to 10.1%, similar to the decline that was reported for non-Aboriginal children (13.2% in 2001–2002 vs. 9.8% in 2008–2010).^{10,13}

In this study, the prevalence of ever-asthma among First Nations children aged 0 to 4 years was 12.9%, which was higher than the 9.4% reported for off-reserve Aboriginal children of 0 to 6 years in 2006² and the 9.9% reported for the age group 0 to 5 years among Canadian children of non-Aboriginal ancestry in 2000–2001.¹³ However, the prevalence of ever-asthma among the First Nations children aged 5 to 11 years in this study was only slightly greater than that reported for off-reserve Aboriginal children aged 6 to 14 years (15.6% vs. 14.3%) in 2006.³ The 14.6% prevalence of asthma among First Nations children aged 0 to 11 years was slightly greater than that reported for children of the same age group (13.4%) in the general Canadian population¹³ and considerably greater than that reported for Indian/Alaska Native children aged 0 to 17 years (9.9%) in 2004–2005.⁶

Asthma prevalence has been reported to be lower among children living in rural areas.¹⁴ A possible reason for the lower prevalence is the “hygiene hypothesis”, which suggests that children residing in rural and farming environments have higher exposure to microbial and infectious agents, and this moderates future immune responses, resulting in a lower incidence of atopic diseases, including asthma.¹⁵ In this study, the overall prevalence of ever-asthma among First Nations children was similar to that reported for Aboriginal and non-Aboriginal children in Canada, raising the possibility that living in the rural environment on reserves may not have an effect on the overall prevalence of asthma in First Nations children. The “rural effect” may have been reduced among First Nations Children because about 50% of First Nation peoples registered in the reserves live in urban areas¹⁶ and not on the reserves, and about 50% of First Nations reserves are located in urban areas.¹⁷

In this study, boys showed a greater prevalence of ever-asthma than girls (16.1% vs. 13.1%), the difference between the two groups being statistically significant after adjustment for other factors. Similar results have been reported for Canadian off-reserve Aboriginal and non-Aboriginal children.^{2,3,13} The difference in the prevalence of asthma between boys and girls is not consistent among Aboriginal children. In a study conducted among off-reserve Aboriginal children aged 0 to 11 years in the Canadian northern territories, boys had a lower prevalence of asthma than girls (4.4% vs. 7.0%).⁴

In the current study, children who were engaged in daily physical activity were less likely to have a report of asthma than those who were never engaged in physical activity. Our results are similar to those reported in a recent systematic review and meta-analysis examining the association between physical activity and asthma in children, adolescents and adults.¹⁸ In that review, subjects with higher physical activity levels had a lower incidence of asthma in an analysis restricted to longitudinal studies.¹⁸ The protective effect of physical activity may be related to the possibility that children with asthma-like symptoms restrict themselves to lower physical activity levels in order to reduce these symptoms. In contrast, in the International Study of Asthma and Allergies in Childhood Phase III, vigorous

physical activity was positively associated with asthma symptoms in children aged 13 to 14 years but not in children aged 6 to 7 years.¹⁹ This may be because vigorously active children who are genetically at high risk of developing asthma (e.g., with family history of asthma) may stress their systems enough to notice asthma-like symptoms, leading them to access health care and a subsequent diagnosis of asthma.

In contrast to the findings in non-Aboriginal children and Aboriginal children living off-reserves, children from households with higher income in this study were more likely to have received a diagnosis of ever-asthma than those from households with lower income.^{1,3} The higher-income households are associated with higher education, and the parents are likely to seek health care for their children more frequently, which might increase the likelihood of asthma being diagnosed.

In this study, children living in smoke-free homes were more likely to have a report of ever-asthma than those children living in homes where occupants smoked inside the home. While counter-intuitive, this finding is not unusual because there is a tendency for occupants of the household to reduce tobacco smoke exposure (e.g., to smoke outside) if a child has asthma-related symptoms. In a study examining the smoking behaviour of parents with children with persistent asthma, about 50% of the children lived with a smoker at home and, of these, 64% of the households had restrictions on smoking in the home or car.²⁰

The “sibling effect” on asthma has been investigated in several studies in the context of the hygiene hypothesis, and the results from these studies have been inconsistent.²¹ The presence of siblings at home increases the chance of developing infections in early life, and according to the hygiene hypothesis these infections in early life protect against the development of allergic diseases, including asthma, in children.²² In this study, children from homes with 2 or more children aged less than 11 years were less likely to have received a diagnosis of ever-asthma, whereas children from homes with 1 to 2 children aged 11 to 17 years were more likely to have received this diagnosis.

There was a significant interaction between birth weight and allergy in the association with ever-asthma. Among children with low birth weight, children with allergy were highly more likely to have ever-asthma in comparison with those without allergy. This association was weaker among children with normal birth weight. The observed differences might be related to the complex relationship between birth weight, immunity/allergy and asthma in children. In the studies involving young and older off-reserve Aboriginal children, low birth weight and allergy were significantly associated with ever-asthma.^{2,3} In contrast, low birth weight was not associated with risk of asthma during the first six years of life in a very large birth cohort study from Minnesota, US.²³ However, only family history of atopic disease but not a child’s allergy was considered as a possible risk factor in that study.²³

Children with ear infections were more likely in the current study to have received a diagnosis of ever-asthma than those who did not have a report of ear infections. This association was stronger in girls than boys. In an analysis of the data on 7,538 children aged 2 to 11 years who participated in the Third National Health and Nutrition Examination Survey conducted in 1988

to 1994, there was a dose-response relationship between number of ear infections and physician-diagnosed asthma after potential confounders had been controlled for.²⁴ In young off-reserve Aboriginal children, chronic ear infection was significantly associated with ever-asthma.⁵ In a non-Aboriginal population, the prevalence of ear infection was reported to be greater among boys than among girls.²⁵ The contradictory finding among First Nations children in this study might be related to the non-significant difference in prevalence of ever-asthma between boys and girls, which is in contrast to the significantly greater prevalence of ever-asthma being reported in boys than in girls in other studies.²⁶

This study is the first comprehensive analysis of asthma morbidity in First Nations children living on reserves. The study identified several factors associated with ever-asthma, which were similar to those reported for Aboriginal children living off-reserve and non-Aboriginal children in Canada. An additional strength of the study was that the RHS sample was representative of children living in First Nations communities in all provinces and territories except Nunavut. There are, however, several limitations to our study. The RHS, a general health survey, was not especially designed to collect information on respiratory health. Since the RHS was cross-sectional, temporal relationships between the exposure and outcome cannot be determined in this study. The parental report of asthma has widely been used in population-based epidemiological surveys conducted in Aboriginal children in Canada²⁻⁴ and other countries.⁶ Validation studies conducted in Canada, Norway and the UK have shown that the parental report of asthma in children has high sensitivity and specificity.²⁷⁻²⁹ In a small pilot study of 36 school-aged First Nations children living on a reserve in Alberta, although the proportion of children with a parental report of ever-asthma (19.4%) was lower than the proportion of children with airflow obstruction (25.0%), three of the seven children with ever-asthma had airflow obstruction, resulting in a significant association between ever-asthma and airflow obstruction.³⁰

In conclusion, the overall prevalence of ever-asthma and factors associated with ever-asthma among First Nations children living on reserves were similar to those reported for off-reserve Aboriginal children and non-Aboriginal Canadian children.

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RÉSUMÉ

OBJECTIFS : Explorer la prévalence et déterminer les facteurs de risque de l'asthme chez les enfants des Premières Nations de 0 à 11 ans vivant dans les réserves au Canada.

MÉTHODE : Dans cette étude transversale, nous avons examiné les données recueillies dans le cadre de l'Enquête régionale longitudinale sur la santé des Premières Nations auprès de 6 657 enfants vivant dans 238 communautés des Premières nations dans les 10 provinces canadiennes, les Territoires du Nord-Ouest et au Yukon.

RÉSULTATS : La prévalence globale d'asthme ayant duré ou devant durer au moins six mois (« asthme passé ») chez les enfants vivant dans les réserves était de 14,6 % : elle était de 12,9 % chez les 0 à 4 ans et de 15,6 % chez les 5 à 11 ans. La prévalence de l'asthme passé était plus élevée chez les garçons (16,1 %) que chez les filles (13,2 %). Les enfants des ménages comptant

deux enfants ou plus de moins de 11 ans et les enfants qui faisaient de l'activité physique quotidiennement étaient moins susceptibles de déclarer de l'asthme passé. Les enfants des familles à revenu élevé et ceux vivant dans des foyers sans fumée étaient plus susceptibles de déclarer de l'asthme passé. L'association entre les allergies et l'asthme passé était plus forte chez les enfants avec insuffisance de poids à la naissance. L'association entre les otites chroniques et l'asthme passé était plus forte chez les filles que chez les garçons.

CONCLUSIONS : La prévalence globale de l'asthme passé et les facteurs associés à l'asthme passé chez les enfants des Premières Nations vivant dans les réserves étaient semblables aux résultats déclarés pour les enfants autochtones vivant hors des réserves et pour les enfants canadiens non autochtones.

MOTS CLÉS : asthme; enfant; Premières Nations; prévalence; facteurs de risque