University of Alberta

Prevalence and Risk Factors of Asthma in
Off-reserve Canadian Aboriginals

by

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Abstract

This study used the data from the Aboriginal Peoples Survey 2006 to determine the prevalence and risk factors for asthma in off-reserve Canadian Aboriginal children aged 6 to 14 years and adults aged 15 to 64 years. The prevalence of asthma was 14.3% in children and 14.0% in adults. Children and adults with Inuit ancestry had significantly lower prevalence of asthma than those with North American Indian and Métis ancestries. Significant risk factors for ever asthma in children included male sex, allergy, low birth weight, obesity, poor dwelling conditions and urban residence. In adults, risk factors for ever asthma varied between Aboriginal groups. Risk factors were also different for early and late onset of asthma among Aboriginal adults. Lower prevalence and difference in the risk factors for asthma in Inuit adults in comparison to other Aboriginal groups might be related to the distinct lifestyle and require further investigation.

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[Disclaimer: The research analysis and results are based on data from Statistics Canada and the opinions expressed herein do not represent the views of Statistics Canada.]

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List of Abbreviation

APS	Aboriginal Peoples Survey
BMI	body mass index
CDC	Center of Disease Control
CI	confidence interval
COPD	chronic obstructive pulmonary disorders
FEV1	forced expiratory volume in one second
IgE	immunoglobulin E
NAI	North American Indian
OR	odds ratio
PMK	the most knowledgeable person in the household
RSV	respiratory syncytial virus
SES	socio-economic status
Th	T helper (lymphocyte)

Chapter 1 Introduction

Asthma is a prevalent chronic disorder, characterized by symptoms of wheezing, breath shortness, chest tightness, and coughing. Although asthma is more common in children, it can affect all age groups. The World Health Organization estimates that there are currently 300 million people suffering from asthma worldwide, making this an important public health issue for all people (1). In Canada, 8.4% of the population aged 12 years and above have been diagnosed with asthma by a physician (2). The etiology of asthma is complex and is not completely understood. Asthma is commonly believed to be caused by the interaction between genetic and environmental factors based on the varying prevalence of asthma between ethnic groups and geographical areas (3); however, only a few studies, to date, have investigated asthma morbidity in the Canadian Aboriginal population, who have different ethnic backgrounds, living environments and lifestyles, and may experience a prevalence and risk factors for asthma that are different from non-Aboriginals.

A study in the 1970s reported that asthma was rare among Canadian Inuit (4). In the province of Saskatchewan, a study using the physician claims database to estimate asthma prevalence from 1990 to 1998 reported that Registered North American Indians aged 5 to 34 years had a lower asthma prevalence compared to non-Aboriginals (5). In contrast, a more recent study based in Alberta reported that emergency room visits for asthma were 2.1 times more common in Aboriginals compared to non-Aboriginals in Canada (6). Additionally, according to the 2001 Aboriginal Peoples Survey, the prevalence of ‘ever asthma’ was 11.6% among Aboriginals aged 15 years and older and 12.1% among those aged 6 to 14 years old— suggesting an increase in the prevalence of asthma in the past few decades (7); thus, further investigation on the prevalence and risk factors for asthma in the Canadian Aboriginal population is needed.

The 2006 Aboriginal Peoples Survey (APS) had a very representative, large sample size for the Canadian Aboriginal population, comprising over 15,000

children and 25,000 adults across Canada (8). Information on lifestyles and living conditions was collected, providing researchers an opportunity to study the epidemiology of asthma in the Aboriginal population. With the aim of understanding the epidemiology of asthma in the Canadian Aboriginal population, this study used data from the 2006 APS to determine the prevalence of ever (lifetime risk) and current (within the past 12 months) asthma in the off-reserve Canadian Aboriginal children and adults. Risk factors associated with asthma were identified in previous literature and are discussed in the next chapter. The associations between those factors and asthma in the Canadian Aboriginal population were examined in the study.

Chapter 2 Literature review

2.1. Background

Asthma is a disorder of chronic airway inflammation resulting in airflow limitation. Common symptoms include wheezing, coughing, shortness of breath, and chest tightness. These symptoms may not all present together when asthma occurs, and they can vary from person to person or from one episode to the next. Asthma occurrence may be infrequent and periodic; also the severity of the symptoms can be mild, moderate, and severe. Reversible airway obstruction is the key feature of asthma which is usually determined in clinics by observing the pre/post bronchodilator changes in peak expiratory flow rates or forced expiratory volume in one second (FEV1) (9). In large population-based epidemiological studies, the presence of asthma is usually determined from an affirmative response to the question "Has a doctor told you that you have asthma?" which is included in a self-report questionnaire (10). The self-report of asthma has been shown to have acceptable validity in comparison to pulmonary test measurements (11).

2.2. Asthma morbidity in Canada

Asthma is one of the most prevalent chronic disorders in Canada. According to the Canadian Community Health Survey 2003, 8.4% of the Canadian population aged 12 years and above have been diagnosed with asthma by a physician (2). The prevalence of ever asthma in Canadian children was 15.7% for the age group of 6 to 9 years and was 17.6% for the age group of 10 to 11 years old, according to the National Longitudinal Survey of Children and Youth 2000/2001 (12). Not only does asthma affect people's health, but it also results in loss of quality of life as well as productivity. Asthma was reported in one study as the leading cause of school absenteeism and the third leading cause of work loss (13). Additionally, asthma places a heavy financial burden on the Canadian health care system at an estimated annual expenditure of 600 million dollars for asthma related illness (14).

2.3. Prevalence and incidence of asthma in Canadian Aboriginals

2.3.1. Demographics of the Canadian Aboriginal population

In the 2006 Canadian Census, the number of people who identified themselves as Aboriginals, including North American Indian, Métis, and Inuit, had increased to 3.8% of the total population of Canada (15). Of the total 1,172,790 Aboriginals residing in Canada, North American Indians represented the majority at 60%; Métis accounted for 33% of the Aboriginal population, and the Inuit represented 4% (15). At the time of the census, almost half of the Aboriginal population (49%) lived in urban areas, 20% lived in rural non-reserve areas, and 31% lived on reserves and settlements—about 68% of the off-reserve Aboriginals lived in urban areas (15). Among the urban Aboriginal population, almost 50 % lived in 10 of the 27 metropolitan cities in Canada. Of the off-reserve Aboriginals, approximately 62% resided in Western Canada, 19% in Ontario, 8% in Quebec, 5% in Eastern Canada, and 5% in Yukon, Nunavut and Northwest Territories (15).

2.3.2. Prevalence of asthma in Canadian Aboriginals

Only a few studies have investigated asthma epidemiology in the Canadian Aboriginal population. Asthma was rare in Canadian Aboriginals before the 1970s. A review of all admissions in an Edmonton hospital from 1946 to 1973 identified only three cases requiring hospital admissions for asthma (4). Studies by Senthilselvan et al. investigated asthma morbidity among Registered North American Indians in the province of Saskatchewan over the course of three decades between 1970 to 2000, and a significant increase was reported in asthma hospitalization rates among children aged 0 to 4 years and adults aged 35 to 64 years from 1970 to 1989 and in asthma prevalence among children and adults in the same ages from 1991 to 1998 in comparison to the non-Aboriginal Saskatchewan population (5, 16). In a population-based study in Alberta, Aboriginals had more emergency room and physician office visits for asthma than

non-Aboriginals in 1996 and 1997 (6). Also in this study, Aboriginals were less likely to see a specialist and to undergo spirometry than non-Aboriginals (6). Contrary to the studies in Alberta and Saskatchewan, a study conducted in the three Northern Territories reported that Aboriginal children at age 11 and under had lower asthma prevalence than non-Aboriginal children; however, the prevalence of wheezing was similar in the two groups (17). Another study found that 6% of Inuit school children between the ages of 6 to 13 years in Northern Québec had the parental report of wheezing in the previous 12 months and 5.3% had evidence of atopy (18). From the results of the 2001 Aboriginal Peoples Survey, the prevalence of ever asthma was 11.6% among Aboriginals aged 15 years and older and 12.1% among those aged 6 to 14 years respectively (7).

2.4. Asthma etiology

Because of the variations in asthma prevalence between ethnic groups and geographical areas, researchers believe that genetics, environment and their interactions are important factors associated with the development of asthma (19). The etiology of asthma has not been well understood. Important risk factors associated with asthma were identified in the literature and are reviewed in the following sections—sex and age; ethnicity/race; rural residence and farming environment; allergy; breastfeeding; infections; tobacco smoking and passive smoking exposure; low birth weight and gestational age; exposure to indoor allergens; obesity; psychological factors; and socio-economic status (SES). The terms “asthma” and “risk factor” were used as the keywords to identify published literature on risk factors for asthma on Ovid Medline.

2.4.1. Age and sex

Many studies have consistently shown that an individual’s age and sex are risk factors for asthma. Asthma affects people of all age groups, yet it is more prevalent in children. Adult asthma is potentially a reoccurrence of childhood asthma although it can develop in an individual in adulthood. The lifetime risk for

physician-diagnosed asthma was examined in Ontario, Canada, and the asthma incidence was the highest before 10 years of age and remained high throughout life (20). Also asthma incidence was reported as higher in children than adults in the United States (21).

Studies have consistently reported a different incidence and prevalence of asthma between sexes. A review of sex effect on asthma found in most studies among children younger than age 15 that boys were about 1.5 times likely than girls to have asthma, but the pattern was reversed in adolescents and adults with asthma being more prevalent in women (22). In the 26-year follow-up in a New Zealand birth cohort study, researchers found that males and females had a similar risk of developing wheeze; however, males tended to develop childhood wheeze, while females were more likely to develop wheeze between age 10 to 26 years (23). Similar results were observed in a British study which investigated asthma incidence from birth to age 23 years (24). Among children aged 0 to 16 years, the incidence of asthma in males was found as about 1.5 times greater than females; however, the incidence of asthma in males became only a half of that in females when they grew up to the age of 17 years and older (24). The difference between sexes in asthma might be potentially due to hormone changes in puberty—influencing an individual's airway size, lung function parameters and inflammatory conditions (25).

2.4.2. Ethnicity/race

Ethnicity has been identified as a significant risk factor for asthma. Blacks and Hispanics in the United States had a higher prevalence of asthma compared to other races (26). Canadian non-Aboriginal children in the Territories were reported as having a greater likelihood of developing asthma compared to Aboriginals (17). The disparities in asthma prevalence between ethnicities could possibly be largely explained by income level, education level, and area of residence, yet some authors have suggested socio-economic status was unlikely to be a sole explanation (27, 28). Genetic variation and gene-environment

interactions also seem likely to have contributed to the differences in asthma prevalence between ethnic groups.

2.4.3. Rural residence and farming environment

Several studies have reported that children brought up in rural areas or farming environments had a lower prevalence of asthma than children residing in non-farming environments. A lower prevalence of asthma was reported among farmers' children in Germany, aged 5 to 7 years, and the protective effect against asthma seemed stronger in children whose families engaged in farming on a full-time basis compared to those farming on a part-time basis (29). A study investigated children aged 8 to 10 years from a mostly rural area in Austria and found that the prevalence of asthma and positive skin-prick tests were significantly lower in children from a farming background (30). Canadian studies have also consistently reported that children and adolescents raised on a farm had a lower risk for asthma (31, 32). The exposure to livestock and exposure to endotoxin in early childhood might contribute to the protective effect of living in farming environments; air pollution and allergens associated with urbanization might be a reason why urban children had a higher risk for asthma (33, 34).

2.4.4. Allergy

Asthma has been routinely described as an allergic disease because numerous studies have consistently demonstrated a strong association between atopy and the development of asthma (35-38). Patients who are exposed to allergens over a long period tend to develop asthma through airway inflammation, bronchial hyper-responsiveness, and reversible airway obstruction. Total serum immunoglobulin E (IgE), allergen-specific serum IgE or positive skin-prick tests to specific allergens are used to diagnose atopy. Children with chronic atopy in early childhood showed a significantly higher prevalence of ever asthma at 10 years in a birth cohort study in the UK, compared to non-atopic children (35). Allergy to cockroaches was reported as strongly associated with increased hospitalizations,

unscheduled medical visits, an increased number of days with wheezing, and increased school absenteeism among inner-city children (36). Among adults aged 18 to 40 years from Italy, a study found that having allergic rhinitis or sensitization to common allergens increased more than two fold the risk of developing asthma (37). Atopy appears to be an important risk factor for asthma even in countries with low asthma prevalence. In China, a country with a lower prevalence of asthma, a strong correlation between atopy and asthma or current wheeze was reported by a study using the International Study of Asthma and Allergies in Childhood questionnaire along with skin-prick tests (38).

Since allergic sensitization is commonly observed in families, many studies have investigated the association between the parental history of allergic diseases and the development of asthma in children. Having an asthmatic parent was reported to be associated with an increased risk for asthma among children between the ages of 9 to 11 years in a large German population study; however, the association with parental allergic rhinitis or parental atopic dermatitis was not statistically significant (39). The risk for developing asthma in infants and toddlers aged 0 to 5 years was also strongly associated with maternal asthma, as reported in a cross-sectional study from Boston, USA, whereas paternal asthma did not show a similar association. However, among children aged 5 years and above in the same study, both maternal and paternal asthma had similar risks for asthma (40). In North Eastern China the association of asthma and both parents' history of allergy/asthma were examined in elementary school children, where maternal asthma was found to have the strongest association (41). Paternal asthma and maternal allergies were also significantly associated with asthma, yet paternal allergy was not (41).

Prospective studies, allowing for the temporal sequence, have been performed to investigate the role of allergy in asthma development. A birth cohort study from the UK showed that a mother with allergic diseases was a significant risk factor for asthma in children (35). Another study using the data from the Canadian Early Childhood Development Cohort found a significant association between

parental atopy and asthma incidence among preschool children (32). Previous studies have consistently reported the strong association between asthma and a family history of allergy and asthma— emphasizing the role of genetic factors in the development of asthma.

2.4.5. Breastfeeding

Studies of the association of breastfeeding and asthma have been contradictory. Some studies have reported that breastfeeding has a protective effect for the development of asthma, while others have reported that breastfeeding has no effect or even results in an increased risk for the development of asthma in children. Breast feeding was reported as associated with a decreased risk for respiratory allergy in later childhood in a 17-year follow-up study in Finland (42). A Dutch 8-year follow-up study, with a larger sample size but a shorter follow-up period, showed that breastfeeding for 16 months or greater was significantly associated with lower asthma prevalence from 3 to 8 years of age (43). An association between less frequent breastfeeding and increased risk for asthma was reported in an Australian study following up a birth cohort up to age 6 years (44). In contrast, the prevalence of asthma was not influenced by breastfeeding in a cross-sectional study of 13,135 British children at age 5 (45). Additionally, breastfeeding was found to increase the risk for asthma among children at 7 years in a British study (46). Also in a prospective study from Tucson in the USA, breastfeeding increased the risk for asthma development in atopic children with maternal asthma, compared to non-atopic children or atopic children with no maternal asthma (47).

The contradictory results for the relationship between breastfeeding and asthma may be due to differences in methodologies and quality of the studies, such as retrospective or prospective study design, small or large sample sizes, durations of breast-feeding, exclusive or any breast-feeding, recall bias or differences in the definition of asthma. The complexity of the elements in breast

milk and its interaction with infants' digestive systems could furthermore be a possible reason for the inconsistent findings (48, 49).

2.4.6. Infections

Infections play a role in the development of asthma. In epidemiological studies, daycare attendance is used as an indicator of infections in early childhood because children attending daycare programs are in contact with other children and likely have higher chances of getting infections. Early daycare attendance was reported as a protective factor for children aged 2 to 5 years in a Canadian longitudinal study of preschool children (32). In contrast, daycare attendance was reported as a risk factor for asthma in several studies (50). A birth cohort study in the Netherlands found that early daycare experience was associated with more airway symptoms in children until 4 years of age, and with fewer symptoms between the ages of 4 to 8 years; however, no protective effect was seen beyond age 8 (51). The unclear association between daycare attendance and asthma development might be due to the differences in methodologies, definitions of asthma, types of daycare centers, and measures of length and ages of daycare attendance in the previous studies. In addition to daycare attendance, studies also used having siblings as an indicator of increased chance of getting infections and have shown that having older siblings had a protective effect against the development of asthma in children (32, 52).

The protective effect of early childhood infections against asthma is associated with the "Hygiene hypothesis" (53, 54). This suggested that there are two types of T-helper (Th) lymphocytes: Th1 and Th2. Th1-mediated immune responses are triggered by intracellular pathogens such as viruses or bacteria, while Th2-mediated immune responses produce IgE and promote allergic inflammation. By activating one system, the other tends to be suppressed. Thus, exposures to infections in early childhood may influence the immune system developing towards Th1-mediated immunity and may suppress the allergic response. As a result, the risk for asthma would decrease.

Not all infections are protective against asthma, though. There have been studies suggesting that viral respiratory infections, especially respiratory infections, are significant risk factors of asthma. Respiratory syncytial virus (RSV) is the most common virus causing lower respiratory tract illnesses in infants, and infants with RSV bronchiolitis are more likely to develop recurrent wheeze and asthma during childhood (55-59). A matched case-control study of children at age 7 from Sweden indicated that children who were hospitalized with RSV bronchiolitis had an odds ratio of 12.7 for asthma (95% CI: 3.4-47.1) compared to controls (57). RSV lower respiratory tract illness was also reported to be associated with increased risk for frequent wheezes (OR=4.3, 95% CI: 2.2-8.4) among children up to 13 years old in a Tuscon study (58). Interestingly, most children were infected with RSV at least once by 2 years of age, but only a proportion went on to develop recurrent wheeze and asthma later in life. Therefore, it has been suggested that other genetic and environmental factors also contribute to the development of asthma in addition to infections (55).

Recent studies have drawn attention to non-RSV lower respiratory tract infections, and studies have reported that influenza virus and rhinovirus might be associated with the development of asthma (60-62). Respiratory infections with Influenza A were found as the second most common viral respiratory infection associated with the inception of asthma, while RSV respiratory infections were the most common ones (61). Rhinovirus has also been a concern, as rhinovirus bronchiolitis was associated with more severe asthma during infancy, as well as an increased potential for asthma development in the future. Rhinovirus bronchiolitis is less frequent than RSV bronchiolotis (60). Bacterial infections such as Chlamydia pneumonia and mycoplasma pneumonia have been reported to be associated with chronic airway inflammation, yet it remains unclear if they cause or contribute to asthma (63). The difficulties of diagnosing Chlamydia and mycoplasma infections may be a possible reason for this, and further investigations will be needed.

2.4.7. Tobacco smoking and passive smoking exposure

Over 100 chemical compounds in tobacco smoke have been found harmful to human health (64), and tobacco smoking has reported as a risk factor for many chronic diseases including lung cancer and heart disease. Researchers have been interested in the association between smoking and asthma, and several studies have found the co-occurrence of smoking and asthma in adults, suggesting an association between smoking and an increased risk for asthma; however, others have found no association. Female smokers had 1.7 times higher prevalence of asthma compared to female non-smokers in a Canadian study which used the data from the National Population Health Survey 1994/1995 (65). Also, in the National Youth Risk Behaviour in the United States, high school students with current asthma were more likely to report frequent cigarette use and heavier smoking (66). In the International Health Behaviour in School-aged Children Study 2001/2002, the prevalence of smoking between 15-year-old adolescents with and without asthma was compared among six countries (Belgium, Canada, Denmark, Finland, France, and Netherlands) (67). The results indicated that daily smoking was more prevalent in asthmatic adolescents than non-asthmatic subjects (67). On the other hand, no association between smoking and asthma was found in a study of residents of Saskatchewan aged 20 to 65 years, yet the association between wheezing and smoking was statistically significant (5). Another study in the United States also reported no differences in smoking rates between adults with and without asthma (68).

To better understand the temporal pattern in the relationship between smoking and asthma in adults, several longitudinal studies have been performed. In a Finish longitudinal study among adults, no significant association was found between smoking and asthma incidence (69), although smoking was found to be a risk factor in the majority of longitudinal studies. Smoking was reported as a significant risk factor for asthma onset, especially in non-atopic adults, in a longitudinal study in Sweden (70). Additionally, smokers were reported as having a higher incidence of asthma than non-smokers among children aged 9 to 11 years

in a German cohort study (71). There seems to be a sex effect on the association between smoking and asthma, with some studies reporting that the association was stronger or existed only among females (72, 73).

Not only active smoking may be a risk factor for asthma in adults, studies also reported that maternal smoking during pregnancy increased the risk for asthma in early childhood. Maternal smoking during pregnancy was found to increase the risk for wheezing among children up to 30 months old in a longitudinal study in the UK (74). Similarly, maternal smoking during pregnancy of more than 15 cigarettes per day was a risk factor for wheezing in children by 5 years of age in a British cohort study (75). The study also reported that maternal smoking during pregnancy would be a predictor for asthma if the mother continued smoking until the child was 16 years (75). In another British cohort study, maternal smoking during pregnancy was reported as a risk factor for early childhood wheezing and the development of asthma among children up to 7 years old, but not among children between the age of 7 and 16 years (76).

Studies showed environmental tobacco exposure in a household, especially maternal smoking, increased the risk for wheezing, yet it was less strongly associated with the incidence of asthma among school-aged children (77). Even though the linkage between parental smoking and asthma development is not well understood, studies have shown that asthma severity was positively related to household tobacco exposure (77, 78). Environmental tobacco exposure remains a concern for asthma, and its role in the development of asthma needs to be investigated further.

2.4.8. Low birth weight and gestational age

Many studies have investigated the association between low birth weight and asthma, as it is an indicator of prematurity, with which babies may be susceptible to asthma development due to immature lung capacity (79, 80). Low birth weight (< 2,500g) and short gestational age (less than 38 weeks) have been reported to increase the risk for asthma development. A recent British study found that low

birth weight (< 3,000g) was a significant predictor for asthma in children aged 2 and over, and short gestational age (24-37 weeks) was significantly associated with risk of admission to hospital for asthma (81). Similar results were reported in a study in Denmark that both low birth weight (< 2,500g) and short gestational age (before 37 weeks) were risk factors for asthma (79). Another Canadian study using data from the National Longitudinal Study of Children and Youth reported that low birth weight (< 2,500g) was a risk factor for asthma development among infants and toddlers (32). Birth weight, considered as a continuous factor, was associated with asthma prevalence among children aged 1 to 5 years in a cross-sectional study in the United States (82).

2.4.9. Exposure to indoor allergens

Epidemiological studies have suggested that an increasing level of exposure to common allergens may increase the risk of asthma development (83, 84). A study in inner city children aged 3 to 15 years found that asthmatic children had a higher prevalence of sensitization to indoor allergens including dust mites, cockroaches and cats compared to non-asthmatic children (85). Studies have shown that exposure to cockroaches increased the incidence and the prevalence of asthma in the childhood (36, 86). Also, a high level of house dust mites was reported as an increasing risk for bronchial hyper-responsiveness among sensitized children in an Australian study, and the effect was stronger in a humid, sub-tropical region than a dry area (87).

On the other hand, no difference in asthma prevalence was seen between early and late exposure to allergens in children at age 7 in a German prospective study, although sensitization to indoor allergens including dust mites and cats was a risk factor for asthma and wheeze (88). Pet dander is another common indoor allergen, yet the association between pet ownership and asthma remains contradictory. Some studies have indicated that exposure to cats was related to asthma exacerbations, while the others have reported no difference or even decreased risk for the development of asthma in pet owners (84, 89).

2.4.10. Obesity

There has been an increasing prevalence of asthma and obesity in the past few decades, drawing researchers' attention to a potential linkage between the two disorders. A large population-based study in the United States reported that obese children aged 7 to 12 years and adolescents aged 13 to 17 years had higher asthma prevalence (90), and numerous cross-sectional and case-control studies reported that obesity was associated with an increased risk for asthma (91, 92). These studies mainly used body mass index (BMI) to determine overweight and obesity. BMI was a person's body weight in kilograms divided by height in meters square, and in adults, BMI between 25 kg/m^2 and 30 $kg/m^2$and over 30 kg/m^2 were used to define overweight and obesity, respectively. In children, the definitions of overweight and obesity are different from those in adults because children are still growing. Some defined children in the top 10% of BMI at same age as obese, and some used age- and sex-specific cut-off points, commonly based on Cole's method or the Center of Disease Control and Prevention's method (CDC's method) to define overweight and obesity. Cole's method established age- and sex-specific cut-off points for overweight and obesity for children aged 2 to 18 years based on 6 populations from the Great Britain, Singapore, Brazil, Hong Kong, and the Netherlands based on the 6 populations (93). The CDC's method was established on the growth charts for the United States (94).

Several prospective studies, allowing for the clear temporal sequence of events to be identified, were conducted to investigate the relation between obesity and asthma. A study of female U.S. registered nurses showed that the BMI at age 28 years and weight gained after age 18 years increased the risk of developing asthma during the follow-up 4-year period (95). In a Norwegian study following people aged 14 to 60 years for average 21 years, overweight and obese adults, determined by a standardized measurement of BMI, were reported as at higher risk of developing asthma, with a slightly higher risk in females compared to males (96). Also, higher BMI was found as a risk factor for asthma among children up to age 6 in a prospective birth cohort study (44). There might also be a

gender effect, as some studies have reported a positive association between obesity and asthma in females only and not in males (97, 98). Similar results have been found in children and adolescents as well as adults (99, 100).

2.4.11. Psychological factors

Studies have suggested that psychological factors might be associated with asthma. A study from the USA in high-risk youths aged between 16 and 24 years found that asthma patients had higher levels of anxiety and depression in comparison to matched controls without asthma (101). Asthmatic children aged 4 to 9 years were reported to have more behaviour problems in an inner city study, and their caregivers had higher levels of psychological distress as well (102). Lifetime and current severe asthma were associated with an increased likelihood of anxiety disorders in a study from German population aged 18 to 79 years (103). Additionally, there was an association between asthma and depressive or anxiety disorders in adolescence and in the young adulthood, reported by a study in the United States (104). There remains the difficulty of identifying the temporal sequence of events for the possible association. The breathless symptom of asthma may make patients anxious so that they are prone to develop psychological disorders. Also, one study suggested the association between asthma and depressive or anxiety disorders may reflect the effects of common factors associated with both disorders, rather than a direct causal relationship (104).

2.4.12. Socio-economic status (SES)

Many diseases are related to socio-economic status, and researchers have been interested in the association between socio-economic status and asthma for a long time; however, the results seemed conflicting. While some studies reported low socio-economic status was a significant risk factor for asthma, others reported higher asthma prevalence in higher SES groups (105-107), and there have also been studies reporting no association between asthma prevalence and socio-

economic status (108, 109). An inverse association between socio-economic status and the prevalence and mortality rate of asthma was reported in a study using data from the National Health Interview Survey which monitored asthma trends in the United States (105). Severe asthma was more often found in the children of semiskilled or unskilled manual workers in a study in Scotland (106). In contrast, asthmatic children were more often found from a higher social class compared to a lower social class in a study in the Isle of Wight, England (107). Also, a significant relationship was found between low SES and the prevalence of lifetime and current wheeze in children in New Zealand, whereas no association between SES and physician-diagnosed asthma was suggested (108). On the other hand, the odds ratio of mothers with social disadvantages for asthma was not statistically significant after adjusting for the education levels and ages of the mothers as well as the ages for the children according to an Australian 5-year follow-up study (109).

2.5. Early and late onset of asthma

Studies have indicated that adults and children experience different risk factors for asthma (76, 110, 111). Asthma was commonly referred to as an allergic disease, yet studies indicated atopy or allergy was more common seen in childhood asthma than adult-onset asthma (110, 112). A British study reported that childhood wheeze was strongly associated with hay fever, eczema, and pneumonia, and wheezing after age 16 was also associated with smoking (76). Another study investigated the characteristics of asthma between different ages of onset and reported that patients with early onset of asthma had higher total serum IgE, while those with late onset of asthma were more likely to be smokers (110). Adult-onset asthma is typically more associated with viral respiratory tract infections and occupations experiencing repeated exposure to cold air, cigarette smoke, and chemicals (112).

2.6. Summary

Asthma is a common disorder in Canada and places a burden on population well-being and the health care system. The etiology of asthma is complex and unclear, yet a number of genetic and environmental factors have been suggested to be important. The Aboriginal population may experience a different prevalence and risk factors of asthma in comparison to non-Aboriginals, resulting from different ethnic backgrounds, lifestyles, and living environments. Limited studies have been done on Canadian Aboriginals, and more investigations are needed to understand asthma epidemiology in this population.

2.7. Objectives of this study

The objectives of this study were to determine:

- the prevalence and risk factors of ever and current asthma in off-reserve Canadian Aboriginal children aged 6 to 14 years
- the prevalence and risk factors of ever asthma in off-reserve Canadian Aboriginal adults aged 15 to 64 years
- the risk factors for early and late onset of asthma in off-reserve Canadian Aboriginal adults aged 15 to 64 years

Chapter 3 Methods

3.1. Aboriginal Peoples Survey 2006

Data from the Aboriginal Peoples Survey (APS 2006) conducted in 2006-2007 by Statistics Canada, were used in this study. The objective of the APS 2006 was to understand the social and economic conditions of Canadian Aboriginals. The target population was Canadian Aboriginal people of ages 6 years and above on October 31, 2006 living in private dwellings; Aboriginal people living in Indian Settlements or on reserves were excluded from the survey (8). Aboriginal people were defined as those persons with North American Indian, Métis, and Inuit ancestries or identities, and those who were Registered Indians or band members.

The APS 2006, a post-censal survey, was sampled from those reported Aboriginal identities or ancestries on the 2006 census long form. There were four screening questions in the 2006 census long form 2B and 2D: ethnic or cultural origins (question 17), self-identification of Aboriginal (question 18), membership of an Indian Band/First Nation (question 20), and Treaty Indian or Registered Indian status (question 21) (8). Persons who reported with Aboriginal ancestors or identities to these questions formed the sampling frame for the APS 2006. To reduce the survey burden for the respondents, persons who were part of the National Longitudinal Survey of Children and Youth and other post-censal surveys were removed from the initial sample chosen for APS 2006. This resulted in a sample of 61,041 persons for the APS 2006 (8). After excluding non-respondents and those who reported as non-Aboriginals later in the APS 2006, the final sample size for APS 2006 was 48,921.

A multi-stage, stratified random sampling design was used in the APS 2006. Each person was assigned a population weight which was provided by Statistics Canada after adjustment for non-response and overlap with other surveys. The survey design and weights were considered in the statistical analysis to obtain valid estimates for the population parameters.

In the APS 2006 which was a cross-sectional survey, information on lifestyle and living conditions of Canadian Aboriginals were collected. Independent questionnaires for children and youth (6 to 14 years) and adults (15 years and above) were administered in the APS 2006; in addition, Métis and Arctic supplement questionnaires were also included. The questionnaires covered a broad range of questions about the demographic, social and economic backgrounds of Canadian Aboriginals. Parents or guardians completed the Child and Youth questionnaire for children aged 6 to 14 years. With consent from parents, children aged 12 to 14 years were allowed to answer some of the questions. The Adult Core questionnaire was completed by both adolescents and adults who were at age of 15 years and older, and parents' consent was obtained for adolescents aged 15 to 17 years as well. Métis and Arctic supplement questionnaires were completed by adults with Métis ancestry or identity and adults living in the Inuit regions respectively.

Paper questionnaires were used for data collection. The questionnaires were initially prepared in English and French and were translated into 20 Aboriginal languages to enhance communications. Personal interviews were conducted in the Inuit regions, Labrador, and in the Northwest Territories (except Yellowknife), while in the rest of Canada, telephone interviews were implemented. The APS 2006 was conducted from October 2006 to March 2007, and the overall response rate was 80.1% with 48,921 persons participating in the survey.

The data from the APS 2006 were stored in two separate datasets: one for children aged 6 to 14 years and the other for adolescents and adults aged 15 years and older. In addition, some information from the 2006 census was also appended to the datasets. The confidential APS 2006 database was accessed in the Research Data Centre at the University of Alberta after receiving approval from Statistics Canada.

3.2. Factors considered in this study

Ever asthma in children was determined by the response to the question "Does he/she have asthma that has been diagnosed by a doctor, nurse or health professional?" in the Children and Youth questionnaire. The response to the question "Have you been told by a doctor, nurse or other health professional that you have asthma?" in the Adult Core questionnaire was used to determine ever asthma in adolescents and adults. Current asthma in children was determined by the response to the question "Have you had an attack of asthma in the past 12 months?" in the Children and Youth questionnaire. Since there was no question regarding recent asthma attacks or symptoms in the Adult Core questionnaire, current asthma was not determined in the adolescents and adults. Age of asthma onset was determined by the response to the question "At what age were you first told that you had asthma?" in the Adult Core questionnaire. Based on the response to this question, adults were categorized into three mutually exclusive groups: subjects with no report of asthma, subjects with asthma onset at the age of 14 years or earlier and subjects with asthma onset at the age of 15 years or later.

Several independent factors were considered in the study:

- Demographic factors:
  - urban/non-urban residence
  - Aboriginal ancestries
  - sex
  - age
  - region of residence
- Early childhood factors
  - low birth weight
  - ever breast-fed
  - daycare attendance
- Health-related factors
  - allergy
  - psychological or nervous difficulties

    - overweight and obesity
    - smoking habits
    - difficulties of accessing health care
    - general health status, any consultation with a healthcare worker in the past 12 months
    - any hospitalization in the past 12 months
- Household factors
    - dwelling conditions
    - number of siblings
    - number of individuals in the household
- Socio-economical factors
    - low income
    - education level of the most knowledgeable person in the household (PMK's education level)
    - education level
    - labour activity (self-employment or paid work) last week
    - rented/owned house

Non-urban residence included residence in rural areas and Inuit Nunaat. Aboriginal ancestries were determined by a report of ancestors belonging to any group of North American Indians, Métis, and Inuit populations, and people with ancestors belonged to more than one Aboriginal groups were categorized as a group of multiple ancestries. Low birth weight was determined by birth weight below 2,500 grams. Body Mass Index (BMI), divided weight in kilograms by height in square meters, was used to determine the status of overweight and obesity. Sex- and age-specific cut-off points based on Cole's method were use for children and young adults below age of 18 years, and BMI of 25 kg/m^2 and 30 kg/m^2 were used to determine overweight and obesity for adults aged 18 years and older. Low income was determined by the economic family total income below $30,000 a year, with the economic family total income being the sum of the

income of a group of two or more persons who lived in the same dwelling and were related to each other by blood, common law or adoption or the income of an unattached individual who was a person living either alone or with others to whom he or she was unrelated, such as roommates or a lodger. The definitions of other factors could be found in the table of variable list as below.

3.3. Exclusions

A small proportion of participants in the APS 2006 were "false-positive" for Aboriginal status. These people reported in the 2006 Census that they were Aboriginals and were chosen for the APS 2006; however, they reported in the APS 2006 survey that they did not have Aboriginal ancestries. The persons were excluded from this study. Also, persons with missing data for ever asthma were excluded from the study. For adults, in order to limit the misclassification between asthma and other co-morbidities including chronic obstructive pulmonary disorders (COPD), adults aged 65 years and older were excluded as well.

3.4. Statistical analysis

Design weights were included in all the statistical analysis of this study. The estimations of prevalence of ever and current asthma and relative frequencies of factors were calculated by rounded denominators and numerators. Multiple and nominal logistic regressions with population weights were used to estimate odds ratios of possible risk factors for asthma. Variances were estimated by the bootstrap method with 1000 bootstrap weights provided by Statistics Canada. In addition, the variance was multiplied by a factor of 16 to allow for valid estimates of variances by using bootstrap weights generated for post-censal studies. The multiplication was achieved by including a Fay adjustment factor of 0.75 in the SVSET command with the variance option of BRR in STATA.

The purposeful selection method was adopted in model building procedures. Those factors with p-value less than 0.20 in the univariate logistic

regression models were considered in the multiple logistic regression models. Only the clinically important, statistically significant ($p<0.05$) and factors of borderline significance were retained in the final model. SVY commands in STATA 10.0 were used to conduct all the statistical analyses in this study.

3.5. Ethic approval and confidentiality

This study has been reviewed and approved by the University of Alberta Health Research Ethics Board - Health Panel (See Appendix A). Because of the confidentiality, the microdata of the Aboriginal People Surveys can only be accessed in the Research Data Centre, and data release is upon approval from Statistics Canada. In the current study, the total number of a population or a subpopulation is presented after normal rounding to the nearest 10, and only percentages or proportions are showed in the results.

Table 1. List of factors analyzed in the study

Factors	Questions used to determine the factors	Categories
Outcomes		
Ever asthma	Does he/she have been diagnosed with asthma by a doctor, nurse or health professional?	yes/no
Current asthma (for children only)	Has he/she had an attack of asthma in the past 12 months?	yes/no
Age of asthma onset (for adults only)	At what age were you first told (you had asthma)?	< 15 years / ≥ 15 years
Demographic factors		
Urban residence	Residence on urban or rural area, or part of Inuit Nunaat on census day	urban / non-urban
Aboriginal groups	Do any of his/her ancestors belong to any Aboriginal groups of North American Indian, Métis, or Inuit?	North American Indian / Métis / Inuit / Multiple ancestries
Sex	Sex of the child or the respondent	male / female
Age	Age of the child or the respondent	6-9 /10-14 years (for children) 15-34 / 35-64 years (for adults)
Region of residence	Region of residence of the child or the respondent on census day	Prairies / Atlantic / Quebec / Ontario / British Columbia / Territories

Table 1. List of factors analyzed in the study (continued)

Factors	Questions used to determine the factors	Categories
Early childhood factors		
Low birth weight (for children)	birth weight of child, in grams (for children)	< 2,500 g / ≥2,500 g
Ever breast-fed	Was he/she ever breast-fed? (for children)	no / yes
Daycare attendance (for children)	Did he/she attend an early childhood development or preschool program?	no /yes
Health-related factors		
Allergy	Does he/she have been diagnosed with allergies by a doctor, nurse or health professional? (for children) Have you been told by a doctor, nurse or other health professional that you have any other long term condition? (report of allergies for adults)	no / yes
Psychological or nervous difficulties (for children)	Does he/she have been diagnosed with psychological or nervous difficulties by a doctor, nurse or health professional?	no/ yes
Overweight and obesity	BMI index calculated by height and weight of child, using Cole's method to determine standard weight (for children) BMI index calculated by height and weight of respondent, using Cole's method to determine standard weight for persons between age of 15 and 18 years and using BMI 25 and 30 as cut-off points for persons at age of 18 years and above (for adults)	underweight and normal weight / overweight / obesity

Table 1. Variable list of factors analyzed in the study (continued)

Factors	Questions used to determine the factors	Categories
Smoke habit (for adults)	Type of cigarette smoker; smoking of cigars or pipes, or chewing tobacco are not considered	non-smoker / former smoker / current smoker
Difficulties in accessing health care	In the past 12 months, was there ever a time when you felt you needed health care but didn't receive it?	no / yes
Any consultation with a health professional in past 12 months	Seen or talked to at least one health professional in past 12 months	no / yes
Any hospitalization in past 12 months	Ever been an overnight patient in a hospital in past 12 months	no / yes
General health status	General health status of the child or the respondent	excellent or very good / good, fair, or poor
Household factors		
Dwelling conditions	Is dwelling in need of repair?	no / in need of minor repair / in need of major repair
Number of siblings (for children)	How many brothers/sisters does the child have?	no or 1 sibling / 2 or more
Number of persons in household (for adults)	Number of persons in household	1-4 / 5 or more persons

Table 1. Variable list of factors analyzed in the study (continued)

Factors	Questions used to determine the factors	Categories
Socio-economical factors		
Economic family total income	economic family total income per year	< $30,000 / ≥ $30,000
Education level of the person most knowledgeable in the household (for children)	What is the highest level of education person most knowledgeable has ever completed?	completed high school or below / some post-secondary education
Education level (for adults)	highest level of schooling the respondent attained	completed high school or below / some post-secondary education
Labour activity last week (for adults)	Last week, did you work for pay or in self-employment?	no / yes
Rented/owned house (for adults)	Is your home rented or owned by you or another member of this household?	rented / owned

Chapter 4 Results

4.1. Results for children of aged 6 to 14 years

4.1.1. Descriptive analysis

The distribution of demographic factors between Aboriginal groups is shown in Table 2 below. Participants in this study mostly (70%) lived mainly in urban areas. Inuit participants resided mainly in non-urban areas (81.7%). Other differences could also be seen between Aboriginal groups. For example, Aboriginal groups were unequally distributed across Canada; over 50% of North American Indians (NAI) lived in Ontario and the Prairies and about 50% of Métis lived in the Prairies, while over half of Inuit children lived in the Territories. In the NAI group, there was a higher proportion of children with low birth weight and low family income. Among Inuit there was a lower proportion of children ever breastfed, allergy and psychological/nervous difficulties and a higher proportion of children with obesity. Moreover, Inuit children were more likely to be living in poorer condition dwellings, and had more siblings and a lower education level of the person most knowledgeable in the household (PMK's education level) and poorer general health status with more frequent overnight stay in hospitals in the past 12 months compared to other Aboriginal groups. Aboriginal children had a high level of health care utilization with about 70% children in the four Aboriginal groups having had consulted with a health care worker in the past 12 months.

4.1.2. Prevalence and univariate logistic regression for ever asthma in children

The prevalence of ever asthma among all Aboriginal children combined was 14.3%, and among those Aboriginal children with ever asthma, 18.1% had activity limitation resulting from asthma and 65.2% took asthma medication on a regular basis. The proportion of each group with ever asthma for each risk factor and unadjusted odds ratios for the relationship between these factors with ever asthma are shown below in Table 3. Aboriginal children living in non-urban areas had a significantly lower prevalence of ever asthma than those living in urban

areas, Inuit children had the lowest ever asthma prevalence of 5.8%, while the prevalence in other Aboriginal children groups was around 15%. The odds ratio of ever asthma was 0.58 for Inuit children in comparison to the NAI children. Also living in the Territories had a protective effect on ever asthma with children living in the Territories having the lowest ever asthma prevalence of 5.9%.

As shown in Table 3, significant risk factors in the univariate logistic regressions included male sex (OR: 1.61), low birth weight (OR: 1.45), allergy (OR: 6.06), psychological/nervous difficulties (OR: 1.74), dwelling in need of major repair (OR: 1.18), higher PMK's education level (OR: 1.14), and low family income (OR: 1.23). Aboriginal children with allergy had a significant odds ratio of 6.06 for asthma compared to those without allergy, indicating a strong association. The prevalence according to dwelling condition showed an increasing trend in the risk from the group of no need of repair, in need of minor repair, to the group of in need of major repair with the odds ratio of the major repair group reaching statistical significance. Other risk factors had odds ratios mostly between 1 and 2, showing a moderate effect. Furthermore, some risk factors including daycare attendance, overweight and obesity were found to be of borderline significant.

All the factors that were significant at $p < 0.20$ were selected for multiple logistic regression analysis. Although consultation with a health care worker, ever hospitalization in past 12 months, and general health status were significantly associated with ever asthma in the univariate logistic regression, they were not considered in for the multiple logistic regression model. Because asthma patients were expected to have more health care consultations and hospitalization as well as poorer self-perception of general health status, the potential contradictory associations between asthma and these factors were avoided by excluding them in the multiple logistic regression model. Also region of residence was not considered in the multiple logistic regressions, because of the collinearity between region of residence and urban/non-urban areas and Aboriginal groups. Inuit children were mainly residing in non-urban areas in Territories and Québec.

4.1.3. Results from multiple logistic regression analysis for ever asthma

A purposeful selection procedure was used to determine the significant risk factors of ever asthma in the multiple logistic regression analysis. Results from the final multiple regression model are shown below in Table 4 below. Children with Inuit ancestry were significantly less likely to have been diagnosed with ever asthma compared to those with NAI ancestry and non-urban residence was a protective factor for ever asthma. Significant risk factors included male sex, low birth weight, overweight and obesity, allergy and dwelling in need of major repair with odds ratio varying between 1 and 2 for these factors except for allergy (OR: 5.99). Several factors including psychological/nervous difficulties, daycare attendance, and low family income were borderline significant in the multiple logistic regression analysis.

Table 2. Distributions of demographic factors, personal characteristics and household factors in the four Aboriginal children groups* (rounded N=15410)

	NAI	Métis	Inuit	Multiple	Missing†
Demographic factors					
Urban/non-urban residence					
urban	75.9	69.0	18.3	70.6	
non-urban	24.0	31.0	81.7	29.4	
Sex					
girls	47.8	50.1	45.8	49.0	
Age					
6-9 years old	59.1	58.1	54.8	57.7	
10-14 years old	40.9	41.9	45.3	42.3	
Region of residence					
Atlantic	8.0	5.4	8.9	4.1	
Québec	13.7	4.7	21.5	15.0	
Ontario	31.2	19.3	6.1	20.6	
Prairies	28.0	53.0	4.8	44.5	
British Columbia	16.4	16.6	2.4	13.5	
Territories	2.6	0.9	56.4	2.2	
Early childhood factors					
Low birth weight (< 2500g)					
yes	6.4	5.8	5.6	5.9	
Ever breastfed					2.8
yes	69.0	70.3	61.8	71.4	
Daycare attendance					1.5
yes	59.9	64.1	57.1	64.3	
Health-related factors					
Body mass index					11.8
normal or under weight	59.5	59.6	49.5	61.7	
overweight	22.9	24.4	25.6	21.5	
obese	17.5	16.0	24.7	16.8	

Table 2. Distributions of demographic factors, personal characteristics and household factors in the four Aboriginal children groups* (rounded N=15410) (continued)

	NAI	Métis	Inuit	Multiple	Missing†
Allergy					0.5
yes	19.3	18.2	9.5	20.7	
Psychological/nervous difficulties					0.4
yes	4.5	2.7	1.3	4.3	
Household factors					
Dwelling condition					<0.1
no need of repair	47.3	48.8	38.9	45.0	
in need of minor repairs	37.0	37.2	34.2	40.1	
in need of major repairs	15.7	14.1	26.8	14.9	
Number of siblings					1.4
1 or none	40.7	48.4	24.6	42.7	
2 or more	59.3	51.6	75.4	57.3	
Socio-economic factors					
PMK's education level					1.5
High school or lower	42.5	43.8	64.6	37.9	
Some post-secondary	57.5	56.2	35.4	62.1	
Economic family income					0.7
> $30000	73.5	80.5	81.8	76.9	
≤ $30000	26.5	19.5	18.2	23.1	
Health consultation in past 12 months					0.6
yes	73.0	69.4	68.3	74.0	
Hospitalization in past 12 months					0.5
yes	2.8	2.0	5.0	3.6	
General health status					0.1
excellent or very good	83.5	84.7	75.5	83.8	
good, fair or poor	16.5	15.3	24.5	16.2	

*Column percentages are shown in the table. † Indicates the percentages of missing data

Table 3. Prevalence of ever asthma and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal children (round N=15410)

	Prevalence (%)	OR	95% C.I.		p-value
Demographic factors					
Urban/non-urban Area					
urban	15.4	1.00			
non-urban	11.7	0.73	0.65	0.82	<0.001
Aboriginal ancestry					<0.0001
North American Indians	14.2	1.00			
Métis	15.1	1.07	0.94	1.22	0.32
Inuit	5.8	0.37	0.28	0.50	<0.001
Multiple ancestries	15.6	1.11	0.96	1.29	0.15
Sex					
girl	11.4	1.00			
boy	17.1	1.61	1.43	1.80	<0.001
Age					
6-9 years old	14.5	1.00			
10-14 years old	14.1	0.97	0.87	1.01	0.62
Region of residence					<0.0001
Prairies	14.7	1.00			
Atlantic	16.2	1.12	0.93	1.35	0.22
Québec	16.2	1.12	0.95	1.34	0.18
Ontario	14.6	1.00	0.85	1.17	0.96
British Columbia	13.2	0.89	0.75	1.05	0.15
Territories	5.9	0.36	0.28	0.48	<0.001
Early childhood factors					
Low birth weight (< 2500 g)					
no	14.0	1.00			
yes	19.1	1.45	1.20	1.77	<0.001
Ever Breastfed					
no	14.7	1.00			
yes	14.3	0.97	0.86	1.10	0.63

Table 3. Prevalence and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal children (round N=15410) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Daycare attendance					
no	13.6	1.00			
yes	14.9	1.12	0.99	1.26	0.07
Health-related factors					
BMI					0.07
normal or under weight	13.7	1.00			
overweight	15.4	1.15	1.00	1.32	0.06
obese	15.6	1.17	1.00	1.37	0.06
Allergy					
no	8.9	1.00			
yes	37.2	6.06	5.35	6.85	<0.001
Psychological/nervous difficulties					
no	14.0	1.00			
yes	22.1	1.74	1.39	2.19	<0.001
Household factors					
Dwelling condition					0.12
no need of repairs	13.7	1.00			
in need of minor repairs	14.5	1.07	0.95	1.21	0.27
in need of major repairs	15.8	1.18	1.01	1.39	0.04
Number of siblings					
1 or less	14.9	1.00			
2 or more	13.9	0.93	0.83	1.04	0.18
Socio-economic factors					
PMK's education level					
high school or below	13.5	1.00			
some post-secondary	15.1	1.14	1.02	1.28	0.02
Economic family income					
> $30000	13.7	1.00			
≤ $30000	16.3	1.23	1.08	1.41	<0.01

Table 3. Prevalence and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal children (round N=15410) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Other health-related factors					
Health consultation in past 12 months					
no	8.9	1.00			
yes	16.5	2.03	1.74	2.38	<0.001
Ever hospitalization in past 12 months					
no	14.1	1.00			
yes	22.6	1.78	1.35	2.34	<0.001
General health status					
excellent or very good	11.6	1.00			
good, fair, or poor	27.8	2.92	2.59	3.30	<0.001

Table 4. Results from multiple logistic regression for ever asthma in Aboriginal children (Rounded N=13,060)

	OR	95% C.I.		p-value
Urban/Non-Urban Area				
urban	1.00			
Non-urban	0.82	0.72	0.94	0.004
Aboriginal Ancestries				0.005
North American Indians	1.00			
Métis	1.13	0.97	1.32	0.104
Inuit	0.61	0.43	0.87	0.006
Multiple ancestries	1.07	0.91	1.26	0.43
Sex				
girl	1.00			
boy	1.52	1.33	1.74	<0.001
Age				
6-9 years old	1.00			
10-14 years old	1.01	0.88	1.15	0.93
Low birth weight (≤ 2500 g)				
no	1.00			
yes	1.44	1.15	1.80	0.001
Daycare attendance				
no	1.00			
yes	1.13	0.99	1.29	0.08
BMI index				0.02
normal or under weight	1.00			
overweight	1.17	1.00	1.38	0.05
obese	1.24	1.05	1.48	0.01
Allergy				
no	1.00			
yes	5.99	5.26	6.84	<0.001
Psychological difficulties				
no	1.00			
yes	1.27	0.97	1.66	0.08
Dwelling condition				0.04
no	1.00			
in need of major repair	1.27	1.06	1.54	0.01
in need of minor repair	1.08	0.93	1.24	0.31
Economic Family Income Level				
> $30000	1.00			
≤ $30000	1.16	0.99	1.35	0.06

4.1.4. Interaction effects in the final multiple logistic regression model in children

Among the ten risk factors of ever asthma identified in the final multiple logistic regression model, significant interactions were observed between Aboriginal ancestry and sex and between Aboriginal ancestry and allergy respectively. The prevalence of ever asthma by these three factors is shown below in Figure 1 which illustrates the differential patterns elucidating the significant interaction effect in the multiple logistic regression model. Among boys with allergy, the prevalence of ever asthma was the highest in Métis children and followed by Inuit and NAI children. However, among girls and boys without allergy, Inuit children had the lowest prevalence of ever asthma.

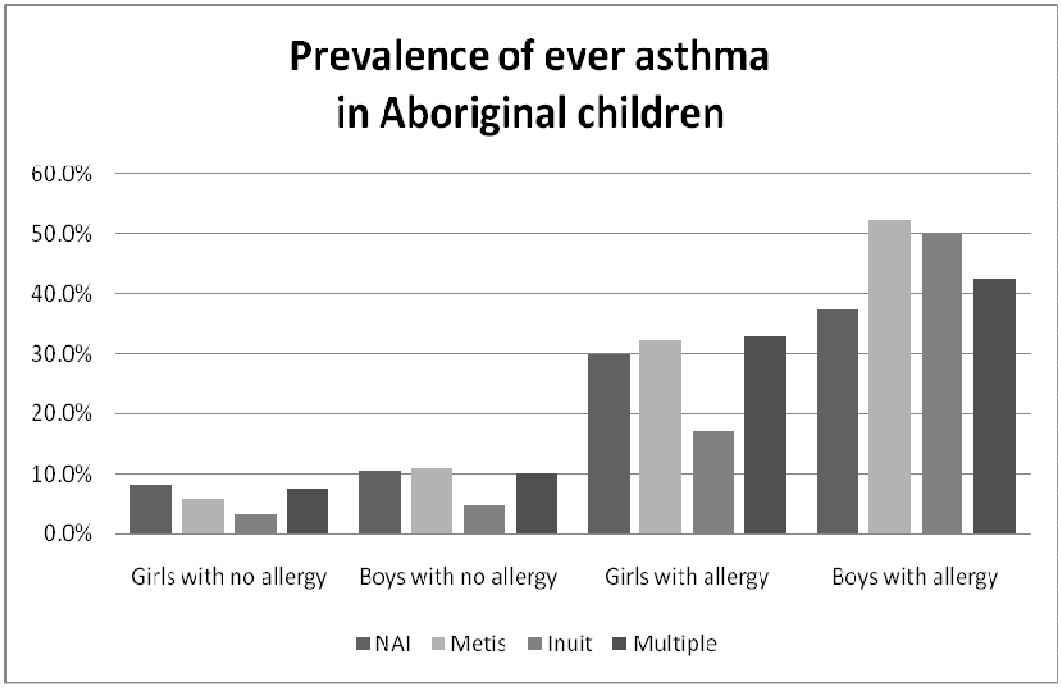

Figure 1. Prevalence of ever asthma by Aboriginal ancestry, sex and allergy

4.2. Prevalence and risk factors for current asthma in children

4.2.1. Prevalence and results from univariate logistic regression in children

The prevalence of current asthma in Aboriginal children aged 6 to 14 years old was 5.7%. The prevalence and odds ratio of potential risk factors from the univariate logistic regression are shown as below in Table 4. Aboriginal children in non-urban areas had significantly lower prevalence of current asthma than those in the urban areas. Children with Inuit ancestry had the lowest prevalence of 2.4% compared to other Aboriginal groups which had prevalence between 5.6% and 6.4%.

Significant risk factors for current asthma from the univariate logistic regression included male sex, low birth weight, obese, allergy, psychological/nervous difficulties, dwellings in need of major repairs, daycare attendance, and higher PMK's education level. Allergy had a strong effect on current asthma, with the prevalence of current asthma being 7-fold higher in children with allergy (OR: 7.23). Psychological/nervous difficulties were also associated with current asthma with the prevalence in children with psychological difficulties being two times higher than those children without. There was an increasing trend in the prevalence of current asthma among Aboriginal children with normal or underweight, overweight, and obese, whereas statistically significant difference was observed between children with obese and normal or underweight. An increasing trend was also observed in the prevalence of current asthma among children living in dwellings without need of repair, in need of minor repair, and in need of major repair presented

As in the analysis of ever asthma, consultation with a health care worker, ever hospitalization in the past 12 months, and general health status were significantly associated with current asthma but were not considered in the multiple logistic regression analysis.

4.2.2. Results from multiple logistic regression analysis for current asthma

Significant risk factors for current asthma in Aboriginal children included urban residence, male sex, low birth weight, obesity, allergy, psychological difficulties, and dwelling in need of major repair. Aboriginal ancestry was no longer significant after adjustment for other factors. None of the interactions between the significant risk factors was statistically significant.

Table 5. Prevalence and results from univariate logistic regression for current asthma in Aboriginal children (rounded N=15390)

	Prevalence (%)	OR	95% C.I.		p-value
Demographic factors					
Urban/non-urban area					
urban	6.2	1.00			
non-urban	4.6	0.74	0.62	0.87	<0.001
Aboriginal ancestries					<0.001
North American Indians	5.6	1.00			
Métis	6.4	1.15	0.95	1.40	0.153
Inuit	2.4	0.41	0.26	0.66	<0.001
Multiple ancestries	6.2	1.11	0.90	1.37	0.346
Sex					
girl	4.7	1.00			
boy	6.7	1.47	1.25	1.74	<0.001
Age					
6-9 years old	5.7	1.00			
10-14 years old	5.9	1.04	0.88	1.23	0.662
Region of Residence					<0.0001
Prairies	5.7	1.00			
Atlantic	6.2	1.09	0.83	1.43	0.534
Québec	6.5	1.15	0.87	1.52	0.315
Ontario	5.7	1.01	0.79	1.29	0.947
British Columbia	6.1	1.07	0.85	1.36	0.552
Territories	2.1	0.36	0.24	0.55	<0.001
Early childhood factors					
Low Birth Weight (< 2500 g)					
no	5.6	1.00			
yes	7.7	1.41	1.04	1.90	0.026
Breastfed					
no	5.5	1.00			
yes	6.0	1.09	0.91	1.32	0.341

Table 5. Prevalence and results from univariate logistic regression for current asthma in Aboriginal children (rounded N=15390) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Daycare attendance					
no	5.1	1.00			
yes	6.2	1.21	1.02	1.45	0.032
Health-related factors					
BMI index					0.120
normal or under weight	5.4	1.00			
overweight	6.0	1.11	0.90	1.37	0.346
obese	6.9	1.28	1.01	1.63	0.043
Allergy					
no	2.9	1.00			
yes	17.8	7.23	6.06	8.63	<0.001
Psychological difficulties					
no	5.6	1.00			
yes	10.3	1.95	1.43	2.65	<0.001
Household factors					
Dwelling condition					0.002
no	5.0	1.00			
in need of major repair	7.6	1.55	1.22	1.96	<0.001
in need of minor repair	5.9	1.17	0.97	1.41	0.097
Number of siblings					
1 or less	5.9	1.00			
2 or more	5.6	0.94	0.79	1.12	0.468
Socio-economic factors					
Parent's education level					
high school or below	4.9	1.00			
some post-secondary	6.5	1.34	1.13	1.60	0.001
Economic Family Income Level					
> $30000	5.5	1.00			
<= $30000	6.5	1.19	0.98	1.45	0.084

Table 5. Prevalence and results from univariate logistic regression for current asthma in Aboriginal children (rounded N=15390) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Other health-related factors					
Health consultation in past 12 months					
no	2.6	1.00			
yes	7.0	2.88	2.19	3.78	<0.001
Ever hospitalization in past 12 months					
no	5.5	1.00			
yes	13.6	2.70	1.90	3.84	<0.001
General health status					
excellent or very good	4.1	1.00			
good, fair, or poor	14.2	3.89	3.24	4.66	<0.001

Table 6. Multiple logistic regression analysis for current asthma in Aboriginal children (rounded N=13140)

	OR	95% C.I.		p-value
Urban/non-urban area				
urban	1.00			
non-urban	0.79	0.64	0.96	0.02
Aboriginal ancestries				0.14
North American Indian	1.00			
Métis	1.23	0.99	1.53	0.06
Inuit	0.76	0.45	1.30	0.32
Multiple ancestries	1.04	0.82	1.31	0.77
Sex				
girl	1.00			
boy	1.29	1.07	1.56	<0.01
Age				
6-9 years old	1.00			
10-14 years old	1.09	0.89	1.33	0.40
Low birth weight (< 2500 g)				
no	1.00			
yes	1.47	1.05	2.04	0.02
Daycare attendance				
no	1.00			
yes	1.18	0.97	1.43	0.09
BMI index				0.06
normal or under weight	1.00			
overweight	1.12	1.05	1.73	0.33
obese	1.35	1.05	1.73	0.02
Allergy				
no	1.00			
yes	7.50	6.22	9.05	<0.001
Psychological difficulties				
no	1.00			
yes	1.46	1.03	2.07	0.04

Table 6. Multiple logistic regression analysis for current asthma in Aboriginal children (rounded N=13140) (continued)

	OR	95% C.I.		p-value
Dwelling condition				<0.001
no	1.00			
in need of major repair	1.78	1.36	2.34	<0.001
in need of minor repair	1.17	0.95	1.45	0.14

4.3. Results for adults (15 years and above)

4.3.1. Descriptive analysis in adults

The distribution of demographic, health-related and household factors between Aboriginal ancestries is shown for adults in Table 7 below. About 70% of participants in this study lived in urban areas, while Inuit mostly lived in non-urban areas. Aboriginal groups were unequally distributed across Canada with over 50% of NAI and Métis living in Ontario and the Prairies, and about 50% of Inuit living in the Territories.

Inuit had had a higher prevalence of current smokers, unemployment, living in rented houses, and living in dwellings in need of major repair. They also tended to have a larger family size, lower education level, and higher proportion of reporting poorer health status and having stayed in a hospital overnight in past 12 months. About 90% of Aboriginal adults had consulted a health care worker in past 12 months, showing their high level of health care utilization.

4.3.2. Prevalence and risk factors for ever asthma in adults

The prevalence of ever asthma among all Aboriginal adults combined was 14.0%. Inuit had the lowest asthma prevalence of 9.7% with NAI, Métis and multiple Aboriginal ancestries group having a prevalence of 13.8%, 13.8%, and 15.3% respectively. Among all Aboriginal adults combined with ever asthma, the proportion of medication use for asthma was 70.4%.

The initial statistical analysis was conducted with all Aboriginal adults combined, and significant factors from the univariate logistic regression included urban/non-urban residence, Aboriginal ancestry, sex, age, region of residence, obese, allergy, number of persons in household, labour activity last week, rented/owned house, economic family income, difficulties in accessing health care, consultation with a health care worker, hospitalization in past 12 months, and general health status (Table 8). All factors with p-value less than 0.20 were included in the multiple regression analysis although region of residence was not selected because of the collinearity with Aboriginal ancestry and urban/non-urban

residence; labour activity last week and rented/owned house were also excluded because the collinearity with other socio-economic factors such as education level and economic family income. Consultation with a health care worker, hospitalization in past 12 months, and general health status were not considered in multiple logistic regression analysis to avoid contradiction. There were eleven factors in the multiple logistic regression model, eight of which were statistically significant associated with ever asthma in adults (Table 9). However, several interactions were found in the multiple logistic regression analysis including those between Aboriginal groups and urban/non-urban area, Aboriginal groups and allergy, Aboriginal groups and education level, Aboriginal groups and difficulties in accessing health care, and age group and standard weight. Therefore, a stratified analysis by Aboriginal groups was utilized (Table 10).

Significant factors for ever asthma in NAI adults were urban area, sex, age group, region of residence, labour activity last week, BMI, allergy, rented house, low family income, and difficulties in accessing health care; factors including number of persons in the household and education level were of borderline significance. Significant factors for ever asthma in Métis adults were similar to those in NAI, but region of residence, allergy, and number of persons in the household were not significant. In Inuit adults, only a few factors were significantly associated with ever asthma: urban area, age, region of residence, smoking habit and education level. Interestingly, the associations with smoking habit and allergy were protective of ever asthma in Inuit adults. Finally, the results of univariate analysis in adults with multiple ancestries were similar to those observed for NAI. Significant factors for ever asthma in adults with multiple ancestries were urban area, sex, region of residence, labour activity last week, rented house, and difficulties of accessing health care. .

Table 7. Distributions of factors between Aboriginal groups in Aboriginal adults* (round N=27190)

Column percentage (%)	NAI	Métis	Inuit	Multiple	Missing†
Demographic factors					
Urban/Non-Urban Area					
urban	76.6	71.2	23.0	73.5	
Non-urban	23.4	28.8	77.0	26.5	
Sex					
female	55.6	56.0	50.1	51.8	
Age					
15-34 years old	45.2	48.7	56.2	40.7	
35-64 years old	54.8	51.3	43.8	59.3	
Region of residence					
Atlantic	8.8	5.9	15.1	5.8	
Québec	19.5	6.2	19.5	19.7	
Ontario	31.9	22.6	6.5	22.8	
Prairies	22.0	48.7	4.8	37.2	
British Columbia	15.4	15.6	2.7	12.8	
Territories	2.4	0.9	51.4	1.6	
Health-related factors					
BMI index					5.9
normal or under weight	42.9	44.9	43.7	40.0	
overweight	33.9	32.0	33.9	34.8	
obese	23.2	23.0	22.4	25.2	
Type of smoker					0.7
non-smoker	33.6	38.9	17.8	34.9	
ever smoker	24.2	23.3	14.3	26.1	
current smoker	42.1	37.8	67.9	39.0	
Allergy					0.5
Yes	0.4	0.4	0.6	0.6	
Household factors					
Dwelling condition					<0.1
no need of repairs	50.7	53.2	43.0	51.3	
in need of major repairs	14.2	11.6	25.7	13.5	
in need of minor repairs	35.2	35.2	31.3	35.2	
Number of persons in the household					<0.1
1 to 4	83.0	81.8	54.4	83.4	
5 or more	17.0	18.2	45.6	16.6	
Socio-economic factors					
Labour activity last week					0.2
yes	63.3	68.5	53.0	66.3	
Rented/owned house					0.9
owned	57.9	67.9	37.5	64.4	
rented	42.1	32.1	62.5	35.6	
Education level					0.2
high school or lower	43.7	45.6	60.6	38.9	
Some post-secondary	56.3	54.4	39.4	61.1	

Table 7. Distributions of factors between Aboriginal groups in Aboriginal adults (round N=27190) (continued)

Column percentage (%)	NAI	Métis	Inuit	Multiple	Missing†
Economic family income level					2.4
> $30000	71.9	78.1	77.6	75.3	
≤ $30000	28.1	21.9	22.4	24.7	
Other health-related factors					
Difficulties in accessing health care					0.7
Yes	11.5	9.1	9.1	12.5	
Health consultation in past 12 months					0.2
yes	90.4	88.5	88.3	90.1	
Hospitalization in past 12 months					0.8
yes	10.2	9.7	12.1	10.7	
General health status					0.1
excellent or very good	58.7	62.0	53.6	59.8	
good, fair or poor	41.3	38.0	46.4	40.2	

*Column percentages are shown in the table. † Indicates the percentages of missing data

Table 8. Prevalence and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal adults (round N=27190)

	Prevalence (%)	OR	95% C.I.		p-value
Demographic factors					
Urban/Non-Urban Area					
urban	15.0	1.00			
non-urban	11.2	0.71	0.64	0.79	<0.001
Aboriginal ancestry					<0.01
North American Indians	13.8	1.00			
Métis	13.8	1.00	0.88	1.14	0.98
Inuit	9.7	0.67	0.51	0.88	<0.01
Multiple ancestries	15.3	1.13	0.98	1.30	0.09
Sex					
female	16.2	1.00			
male	11.2	0.65	0.58	0.73	<0.001
Age					
15-34 years old	15.5	1.00			
35-64 years old	12.6	0.79	0.70	0.88	<0.001
Region of residence					<0.0001
Prairies	13.1	1.00			
Atlantic	13.8	1.06	0.91	1.23	0.43
Québec	12.7	0.96	0.81	1.14	0.66
Ontario	17.7	1..43	1.25	1.63	<0.001
British Columbia	12.0	0.90	0.77	1.07	0.24
Territories	7.1	0.50	0.42	0.60	<0.001
Health-related factor					
BMI index					<0.0001
normal or under weight	13.1	1.00			
overweight	12.2	0.93	0.81	1.06	0.27
obese	17.5	1.41	1.23	1.62	<0.001
Type of smoker					0.90
non-smoker	13.7	1.00			
ever smoker	14.1	1.03	0.88	1.20	0.70
current smoker	14.0	1.03	0.91	1.16	0.69

Table 8. Prevalence and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal adults (round N=27190) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Allergy					
no	13.9	1.00			
yes	28.0	2.42	1.41	4.18	<0.01
Household factors					
Dwelling in need of repair					0.17
no need of repairs	13.7	1.00			
in need of major repairs	13.0	0.94	0.80	1.12	0.50
in need of minor repairs	14.7	1.09	0.97	1.23	0.15
Number of person in the household					
4 or less	14.3	1.00			
5 or more	12.6	0.86	0.75	0.99	0.04
Socio-economic factors					
Labour activity last week					
no	15.9	1.00			
yes	12.9	0.78	0.70	0.87	<0.001
Rented/owned house					
owned	12.7	1.00			
rented	15.8	1.29	1.15	1.44	<0.001
Education level					
≤ high school	14.6	1.00			
> high school	13.4	0.90	0.81	1.01	0.07
Economic family income level					
> $30000	10.2	1.00			
≤ $30000	14.4	1.38	1.23	1.56	<0.001
Other health-related factors					
Difficulties in accessing health care					
no	12.9	1.00			
yes	22.5	1.96	1.67	2.31	<0.001
Ever consulted with a health professional in past 12 months					
no	10.2	1.00			
yes	14.4	1.49	1.20	1.85	<0.001

Table 8. Prevalence and odds ratios from univariate logistic regression for ever asthma by potential risk factors in Aboriginal adults (round N=27190) (continued)

	Prevalence (%)	OR	95% C.I.		p-value
Ever stayed overnight in a hospital in past 12 months					
no	13.4	1.00			
yes	18.8	1.50	1.29	1.74	<0.001
General health status					
excellent or very good	10.6	1.00			
good, fair, or poor	18.9	1.97	1.77	2.20	<0.001

Table 9. Multivariable Logistic Regression for ever asthma in all Aboriginal adults (round N=23840)

	OR	95% C.I.		p-value
Urban/non-urban area				
urban	1.00			
non-urban	0.75	0.67	0.84	<0.001
Aboriginal ancestry				0.15
North American Indians	1.00			
Métis	1.03	0.90	1.18	0.71
Inuit	0.92	0.67	1.26	0.60
Multiple ancestries	1.18	1.01	1.37	0.04
Sex				
female	1.00			
male	0.64	0.56	0.72	<0.001
Age				
15-34 years old	1.00			
35-64 years old	0.74	0.66	0.84	<0.001
BMI				<0.0001
normal or under weight	1.00			
overweight	1.06	0.92	1.23	0.39
obese	1.57	1.36	1.82	<0.001
Allergy				
no	1.00			
yes	2.88	1.57	5.28	<0.01
Dwelling in need of repair				0.04
no need of repairs	1.00			
in need of major repairs	0.87	0.73	1.03	0.10
in need of minor repairs	1.09	0.96	1.24	0.19
Number of person in the household				
4 or less	1.00			
5 or more	0.94	0.80	1.09	0.39

Table 9. Multivariable Logistic Regression for ever asthma in all Aboriginal adults (round N=23840) (continued)

	OR	95% C.I.		p-value
Education level				
high school or below	1.00			
some post-secondary	0.83	0.74	0.94	<0.01
Economic family income level				
> $30000	1.00			
≤$30000	1.23	1.08	1.41	<0.01
Difficulty to access health care				
no	1.00			
yes	1.92	1.62	2.29	<0.001

Table 10. Results from univariate logistic regression of ever asthma in adults for Aboriginal groups

	NAI (round N=11880)			Métis (round N=5470)			Inuit (round N=4700)			Multiple(round N=5130)		
	OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.	
Demographic factors												
Urban/non-urban area (ref: urban)												
non-urban	0.80‡	0.68	0.93	0.73‡	0.59	0.90	0.23‡	0.14	0.39	0.70‡	0.56	0.87
Sex (ref: female)												
male	0.62‡	0.52	0.74	0.68‡	0.55	0.83	0.77	0.44	1.33	0.68‡	0.55	0.85
Age (ref: 15-34 years old)												
35-64 years old	0.82‡	0.70	0.97	0.58‡	0.48	0.71	0.60‡	0.39	0.94	0.94	0.76	1.17
Region of Residence (ref: Prairies)												
Atlantic	1.17	0.97	1.41	0.73	0.49	1.08	0.76	0.28	2.03	1.41ll	0.98	2.03
Québec	0.89	0.70	1.14	0.83	0.58	1.18	0.51	0.17	1.65	1.49‡	1.07	2.06
Ontario	1.58‡	1.32	1.90	1.23	0.94	1.61	1.73	0.44	6.87	1.43‡	1.07	1.90
British Columbia	0.95	0.74	1.21	0.63‡	0.47	0.85	0.84	0.20	3.55	1.37ll	1.00	1.88
Territories	0.44‡	0.31	0.62	0.96	0.55	1.70	0.34§	0.14	0.82	0.99	0.66	1.51
Health-related factors												
Allergy (ref: no)												
yes	3.36‡	1.42	7.92	1.52	0.63	3.64	0.21¶	0.03	1.36	2.06¶	0.81	5.20
BMI index (ref: normal or under weight)												
overweight	0.94	0.76	1.16	0.80ll	0.63	1.03	1.06	0.56	2.00	1.02	0.77	1.34
obese	1.44‡	1.17	1.78	1.15	0.89	1.49	1.50	0.73	3.11	1.62‡	1.23	2.13

Table 10. Results from univariate logistic regression of ever asthma in adults for Aboriginal groups (continued)

	NAI (round N=11880)			Métis (round N=5470)			Inuit (round N=4700)			Multiple(round N=5130)		
	OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.	
Type of smoker (ref: non-smoker)												
ever smoker	1.06	0.85	1.33	0.83¶	0.63	1.09	0.42‡	0.23	0.78	1.25¶	0.94	1.66
current smoker	1.10	0.92	1.34	1.06	0.84	1.34	0.39‡	0.22	0.71	1.00	0.78	1.28
Difficulty to access health care (ref: no)												
yes	2.22‡	1.76	2.81	1.42§	1.05	1.91	1.12	0.59	2.14	1.96‡	1.48	2.61
Household factors												
Dwelling condition (ref: no)												
in need of minor repair	1.06	0.88	1.26	1.25§	1.00	1.55	0.82	0.43	1.56	1.06	0.84	1.35
in need of major repair	1.00	0.77	1.28	1.16	0.86	1.58	0.63ll	0.38	1.02	0.75ll	0.54	1.04
Number of person in the household (ref: ≤ 4)												
5 or more	0.83	0.67	1.03	1.10	0.84	1.46	0.70¶	0.44	1.11	0.82	0.60	1.12

‡ p<0.01; § p<0.05; ll p<0.10; ¶ p<0.20

4.3.3. Results from multiple logistic regression in adults

The four Aboriginal groups had different multiple logistic regression models for ever asthma. Urban residence, sex, age group, obesity, difficulties of accessing health care and allergies were significant for North American Indians, and Métis had a similar model with NAI, including those factors in the model for NAI except allergies (Table 11).

The final multiple logistic regression models for ever asthma in Inuit only contained only three significant factors of ever asthma: urban residence, age group and allergy. There were four significant factors of ever asthma including urban residence, sex, obese and difficulties of accessing health care in adults with multiple Aboriginal ancestries.

Overall, non-urban residence was protective of ever asthma in all Aboriginals and. Males had odds ratio for ever asthma around 0.6 compared to females in adults with NAI, Métis, and multiple ancestries. Obesity and difficulties of accessing health care had significantly increased risk of asthma in adults with NAI, Métis, and multiple ancestries. Allergy was significantly associated with ever asthma in NAI and Inuit but had odds ratio with different directions; it was a risk factor in NAI but protective in Inuit. Moreover, no socio-economic factors were associated with ever asthma in any of the four Aboriginal groups.

4.3.4. Interactions

The two interactions, including one between residence (urban/ non-urban) and BMI, and the other one between sex and age, were significant in the final multiple logistic regression model for people with NAI ancestry. Among Métis, interactions between sex and difficulties in accessing health care, age group and difficulties in accessing health care, and education level and low income were statistically significant. In addition, there was a significant interaction between urban residence and age group in Inuit, and between urban residence and sex in multiple ancestries group, respectively.

Table 11. Results from multiple logistic regression analyses of ever asthma in adults for Aboriginal groups

	NAI (N=10766)			Métis (N=5009)			Inuit (N=4634)			Multiple (N=4840)		
	OR	95% C.I.		OR	95% C.I.		OR	95% C.I.		OR	95% C.I.	
Urban/non-urban area (ref: urban)												
non-urban	0.83§	0.70	0.98	0.78§	0.63	0.97	0.23‡	0.13	0.38	0.68‡	0.54	0.85
Sex (ref: female)												
male	0.60‡	0.50	0.73	0.69‡	0.55	0.85				0.68‡	0.54	0.86
Age (ref: 15-34 years old)												
35-64 years old	0.81§	0.68	0.97	0.56‡	0.45	0.69	0.57§	0.36	0.90			
BMI index (ref: normal or under weight)												
overweight	1.07	0.86	1.33	0.99	0.76	1.29				1.11	0.84	1.48
obese	1.55‡	1.24	1.94	1.36§	1.04	1.79				1.73‡	1.30	2.30
Allergy (ref: no)												
yes	4.86‡	1.88	12.60				0.10§	0.01	0.84			
Difficulty to access health care (ref: no)												
yes	2.23‡	1.73	2.87	1.45§	1.06	1.99				1.83‡	1.37	2.45

‡ p<0.01; § p<0.05; ll p<0.10; ¶ p<0.20

4.4. Risk factors for early and late asthma onset in adults

Possible risk factors for early and late asthma onset were examined in Aboriginal adults using nominal logistic regression in which person with early (14 years or earlier) and late (15 years or later) asthma onset were compared to those with no self-report of asthma. After univariate analysis and purposeful selection procedure, only scientifically important and statistically significant factors were kept in the final nominal logistic model, which consisted of nine factors including urban/non-urban residence, sex, age group, Aboriginal ancestry, BMI index, allergy, difficulties in accessing health care, education level and low family income (Table 12). Non-urban residence and male were protective factors for both groups of early and late asthma onset, while difficulties in accessing health were a risk factor for both groups. Male sex was more protective for late onset of asthma, though; in other words, males were at a higher risk for asthma before 15 years of age. Being in the age group 35 to 64 years was a significant factor for early and late onset asthma but with odds ratios in the opposite direction; it was a protective factor in early asthma onset group but a risk factor for the late asthma onset group. Aboriginal adults with multiple ancestries was a significant factor for only for late onset of asthma Also being obese and low income were associated only with late onset of asthma. However, allergy was significantly associated with early onset of asthma (OR: 3.72, $p<0.01$) and borderline significant association with late onset of asthma (OR: 1.81, $p=0.09$). The effect of allergy was stronger on early onset of asthma compared to late onset of asthma. Education level had a protective effect for both early and late onset of asthma, but it was significant only for the early asthma onset.

Table 12. Multinomial Logistic Regression for asthma onset in Aboriginal adults (rounded N=23790)

	early onset (< age 15 years)				late onset (≥ age 15 years)			
	OR	95% C.I.		p-value	OR	95% C.I.		p-value
Urban/non-urban area (ref: urban)								
Non-Urban	0.66	0.56	0.79	<0.001	0.83	0.72	0.97	0.02
Sex (ref: female)								
male	0.85	0.72	1.00	0.05	0.45	0.37	0.54	<0.001
Age (ref: 15-34 years old)								
35-64 years old	0.28	0.23	0.34	<0.001	2.47	2.06	2.97	<0.001
Aboriginal ancestries (ref: NAI)								
Métis	1.15	0.96	1.39	0.14	0.91	0.74	1.11	0.33
Inuit	0.86	0.50	1.46	0.57	0.99	0.72	1.34	0.93
Multiple ancestries	1.04	0.84	1.29	0.71	1.31	1.07	1.60	<0.01
BMI index (ref: normal or under weight)								
Overweight	1.05	0.87	1.28	0.59	1.10	0.90	1.35	0.33
Obese	1.18	0.95	1.45	0.13	2.06	1.68	2.52	<0.001
Allergy (ref: no)								
Yes	3.72	1.72	8.02	<0.01	1.81	0.91	3.58	0.09
Difficulty to access health care (ref: no)								
Yes	2.03	1.59	2.58	<0.001	1.88	1.51	2.35	<0.001
Education level (ref: high school or below)								
some post-secondary	0.84	0.72	0.99	0.04	0.86	0.72	1.02	0.08
Economic family income level (ref: > $30,000)								
≤ $30000	1.13	0.93	1.38	0.21	1.33	1.11	1.59	<0.01

Chapter 5 Discussion

5.1. Prevalence of current and ever asthma in Aboriginal children and adults

Using a large population database, this study explored the epidemiology of asthma in off-reserve Canadian Aboriginals. The prevalence of current and ever asthma in Aboriginal children, aged 6 to 14 years old, was found to be 5.7% and 14.3% respectively, slightly lower than the prevalence of asthma in the general Canadian population. The prevalence of ever asthma in Canadian children was 15.7% for the age group of 6 to 9 years and was 17.6% for the age group of 10 to 11 years old, according to the National Longitudinal Survey of Children and Youth 2000/2001 (12). Additionally, asthma prevalence was previously reported as lower in Aboriginal children, aged 0 to 11 years, compared to non-Aboriginals in a study in the Northern Territories of Canada (17). The prevalence of asthma seemed to be increasing in Aboriginal children when comparing the results from the current study to those from the Aboriginal Peoples Survey conducted in 2001. The prevalence of ever asthma increased from 12.1% to 14.3% in Aboriginal children (age 6 to 14 years) over the 5-years period (7).

In contrast to the results observed for children, asthma prevalence was 14% in Aboriginal adults (aged 15 to 65 years), higher than that reported in the Canadian general population, where asthma prevalence was 8.5% (at the ages of 12 and over) (113). Similar to the results observed in Aboriginal children, asthma prevalence in Aboriginal adults increased from 11.6% in 2001 to 14.0% in 2006 (7). An increase of asthma morbidity was also reported in studies based in the provinces of Alberta and Saskatchewan (5, 6, 16), where Aboriginals were more likely to be hospitalized and to have emergency room and physician office visits than non-Aboriginals (6).

In the current study, asthma prevalence varied between Aboriginal groups; Inuit had the lowest asthma prevalence among Aboriginal adults, with North American Indian and Métis adults being about 1.5 times more likely to report physician-diagnosed asthma than Inuit adults.

5.2. Factors associated with the prevalence of asthma in Aboriginal children

In the current study, significant factors associated with ever asthma in children included residing in urban areas, male sex, Aboriginal ancestry, low birth weight, allergy, obesity, and poor dwelling conditions. Daycare attendance, psychological or nervous difficulties, and low economic family income were of borderline significance. The significant factors associated with current asthma in Aboriginal children were similar to those for ever asthma, except for psychological or nervous difficulties which was a significant factor for current asthma.

Male sex was be significantly associated with ever and current asthma in Aboriginal children in the current study, with the odds ratio of around 1.5 for the association. The pattern that childhood asthma was more often found in males compared to females has been consistently found in many other studies (22). Males were reported as 1.5 times more likely to develop asthma in comparison to females among children aged 0 to 16 years in a British study (24). A potential explanation for the different asthma prevalence in boys is the hormone change in puberty which might have an influence on airway size, lung function parameters, and inflammatory conditions (25).

Aboriginal ancestry was associated with ever asthma in children, and Inuit children had a significantly lower risk for ever asthma after adjusting for other factors. The prevalence of ever asthma in North American Indian, Métis, and the multiple Aboriginal ancestries group varied between 14% and 16%, which were about 2.5 fold that in Inuit children. The majority of Inuit children still lived in Inuit regions and might have experienced more traditional lifestyles, which might contribute to the lower prevalence of asthma. Also non-urban environments and genetic factors might be related to the lower asthma prevalence in Inuit. Aboriginal ancestry was not significantly associated with current asthma, nevertheless the odds ratio for current asthma in Inuit compared to NAI still showed a protective effect.

Urban residence was consistently identified as a risk factor for asthma in the current study and other studies. Canadian children (aged 0 to 17 years) living in urban areas were found to be at an increased risk for asthma in a study using the 1998 National Health Interview Survey (114). The prevalence of physician-diagnosed asthma from 1990 to 1998 was higher in the urban population of Saskatchewan in comparison to the rural population (5). The hygiene hypothesis might partially explain the difference in asthma prevalence between urban and rural areas, as children living in rural area might have higher endotoxin exposure due to animal contacts, so making their immune systems more prone to a Th2 response. As a result, children living in rural residence were less likely to develop atopic diseases. The exposure effect of endotoxin has usually been described in children exposed at a younger age that was included in this study.

Low birth weight, either considered as a categorical variable of under 2,500 grams or a continuous variable, has been reported to be associated with childhood asthma (79, 115); among Aboriginal children aged 6 to 14 years, low birth weight also showed a statistically significant association. Low birth weight is an indicator of pre-mature birth and may also reflect socio-economic status. Children with pre-mature birth or low birth weight might have underdeveloped lung capacity, which leads them to be prone to asthma development. The significant association between low birth weight and asthma suggested prenatal maturation may have a long term effect on asthma development in children's later life.

The current study found that daycare attendance was a borderline-significant risk factor for ever and current asthma among Aboriginal children. Some previous studies have reported that daycare attendance increased the risk for asthma (50), yet others showed a protective effect (32). Daycare attendance increases the chances of experiencing infections in early childhood; respiratory infections may put children at a greater risk of asthma, yet other types of infections may reduce children's allergy responses. The role of daycare attendance on the development of asthma remains unclear, and characteristics of

daycare centers and length of daycare attendance could have resulted in differences in findings between studies.

Allergy was a significant risk factor of ever and current asthma among Aboriginal children, with the odds ratios being around 6 and 7.5, respectively, indicating a large effect of allergy. Previous studies have consistently showed that allergies including chronic atopy and allergy to cockroach were associated with asthma development, increased hospitalization and unscheduled medical visits for asthma, and school absenteeism due to asthma (35, 36). The data from the APS 2006 did not distinguish between different types of allergies, and the odds ratio reported in the current study indicates the effect of all allergies taken together, including food allergy. The parental history of allergy has been reported as a risk factor for childhood asthma in other studies (39, 40); however, information about the parental history of allergy was not collected in the APS 2006.

Psychological or nervous difficulties were found to be significantly associated with asthma in the current study. Psychological factors have drawn researchers' attention as potential factor associated with asthma over last two decades. Asthmatic children (aged 4 to 9 years) were found to have more behavior problems, reported by an inner city study (102). Also, an association between asthma and anxiety and depression in adolescents and young adults was reported in a 21-year follow-up birth cohort study in the United States (104). Asthmatic children may perceive themselves with poorer health status because of frequent episodes of asthma. The higher anxiety level and negative perception of their health might induce psychological disorders; however, the temporal sequence could not be determined in this study, and consequently it is not possible to identify a possible causative direction. Additionally, a study suggested the association between psychological difficulties and asthma may reflect effects of common factors associated with both disorders, rather than a direct causal relationship (104).

The current study used Cole's method to define overweight and obesity in children, and found a positive association between obesity and asthma. As there is

no specific method to define overweight and obesity in Canadian Aboriginal children, Cole's method might have better validity in the Aboriginal population compared to other methods, because Cole's method was established on 6 different populations. The odds ratios for ever asthma showed an increasing trend from under or normal weight, overweight, to obesity, although only obesity was statistically significant. Previous studies have reported a positive association between obesity and asthma (90, 100), and this relationship might be modified by gender (100); however, no gender effect was found in the current study. The association between obesity and asthma may be two-way mediated. Obese children might have narrower airway and more severe inflammatory response, so the risk of developing asthma would increase. On the other hand, asthmatic children, especially those with greater severity, might have difficulties doing exercises, so they gain weight easily due to lack of physical activities. Studies have tried to clarify the temporal sequence by using a prospective study design, and higher BMI index was reported as a risk factor for asthma in an Australian birth cohort study following children up to age 6 years (44). The relationship between obesity and asthma is complex, and evidence for a causal effect could not be determined in the current study.

Epidemiology studies have shown an increase of asthma prevalence across the world in the past few decades, and the increase likely could not be caused by genetic factors, as they would be unlikely to have changed quickly over this period. Studies have suggested an increasing level of exposure to common allergens might have contributed to the recent increase in asthma prevalence (83, 84). In studies conducted in the United States, exposures to dust mites, cockroaches, and pets were positively associated with the incidence and prevalence of asthma in children (36, 86). However, the status of IgE sensitization to indoor allergens or dust samples from home, and information about pet ownership were not collected in the current study. Dwelling in need of repairs could be considered as a surrogate for older homes and lower socio-economic status. Older homes might be in need of repairs and more likely to be suffering

from dampness and/or moulds. In the current study, 15% of the participants lived in dwellings in need of major repairs, where dwelling conditions were a significant risk factor for asthma. The odds ratios of dwelling conditions revealed a trend with worse housing being associated with a higher risk for asthma.

Many studies have investigated the association between socio-economic status and asthma, and the results are contradictory. Some reported that low socio-economic status was a significant risk factor for asthma, while others reported that asthma was more prevalent in high socio-economic groups; there were also studies reporting no association between socio-economic status and asthma prevalence (105-109). In the current study, low income family was borderline-significantly associated with ever asthma in children but not significantly associated with current asthma. Parental education level was not associated with ever and current asthma. Similar results were reported in a study in New Zealand, which suggested no association between socio-economic status and ever asthma (106). Also, one Australian prospective study reported that no statistically significant differences were found in asthma prevalence between children with and without social disadvantage mothers (109). On the other hand, a study in the United States reported a dose-response relationship between low socio-economic status and prevalence and mortality rate of asthma (105). The difference in the results between the US study and the current study might be related to the differences in healthcare between the two countries. The Canadian health care system should ensure healthcare access to everyone, independent of the socio-economic status; hence, asthmatic children from low income families in Canada could still receive proper treatment, without undue concern about unaffordable cost. In the USA, persons with low socio-economic status likely have limited access to health care and might not be able to receive proper care for asthma.

A larger family size and a larger number of siblings have been reported to be inversely associated with the development of asthma (32, 52); however, number of persons in the household and number of siblings were not associated with ever asthma in Aboriginal children in the current study. Some studies

suggested older siblings, not younger siblings, had a protective effect against the development of asthma, but the information of the order of siblings could not be obtained from the original questionnaires of the APS 2006.

Parental smoking and active smoking have been reported to be a risk factor for asthma. Maternal smoking during pregnancy increased the risk for wheezing and asthma for children, and the effect seemed to be significant in early childhood (74, 76). Daily smoking was found to be more prevalent in asthmatic adolescents aged 15 years in six countries (Belgium, Canada, Denmark, Finland, France, and Netherlands) compared to non-asthmatic subjects (67). Information on smoking habit or parental smoking was not obtained in the APS questionnaires, and the associations between asthma and these factors were not investigated in the current study.

5.3. Factors associated with ever asthma, and early and late onset of asthma in Aboriginal adults

The risk factors for asthma varied between Aboriginal groups except for some common risk factors, such as urban residence and obesity. Urban residence was a significant risk factor for all four Aboriginal groups, and being in the age group of 15 and 34 years was significant in people with North American Indian, Métis, and Inuit ancestry. Obesity, female sex and difficulties in accessing health care were associated with ever asthma in all Aboriginal groups except the Inuit group. Socio-economic status was not a significant factor for ever asthma in any of the Aboriginal groups.

Female sex was significantly associated with ever asthma in adults in all Aboriginal groups, except for people with Inuit ancestry. Female sex was significantly associated, in the opposite (protective) direction, with ever asthma in Aboriginal children. Many studies have consistently reported the patterns that males had a higher prevalence of childhood asthma, where females had greater asthma prevalence in adolescents and adulthood (22). The incidence of asthma for males was reported as 1.5 times greater compared to females at age between 0 and

16 years in a study from the UK, and the pattern changed after the age of 17 years with asthma incidence in males being about a half of that in females (24). Additionally, a New Zealand birth cohort study reported no difference in the incidence of wheezing between sexes at the end of the 26-year follow-up, but males tended to develop childhood wheeze, while females were more likely to develop wheeze after age 10 (23). The difference between sexes in asthma might be due to the different airway size, lung function parameters, and inflammatory conditions which were influenced by hormone change in puberty (25). The odds ratios for the relationship between sex and asthma in the current study were significant and similar to the results in previous studies in all Aboriginal groups, except for those with Inuit ancestry. In Inuit adults, there was not only a non-significant relationship between sex and ever asthma but the odds ratio for female sex also showed a protective effect. This unusual finding might be related to the diagnosis of asthma in this heavy-smoking population which is prone to other respiratory conditions including bronchitis and chronic obstructive pulmonary disease (COPD).

Age was associated with ever asthma in Aboriginal adults. Many studies have found the prevalence and incidence of asthma was higher among children and adolescents compared to adults (20, 21). In the current study, people at the ages between 15 to 34 years had a significantly higher asthma prevalence compared to those at the ages between 35 to 64 years, showing that younger adults were at a greater risk for asthma than older adults. Changes in lung capacity and the immune system as people age might influence the development of asthma; however, diagnostic errors may be a reason as well (116). The symptoms of asthma are similar to those of the chronic obstructive pulmonary disorders (COPD); because COPD were more common in older adults, physicians may be more likely to diagnose older adults as having COPD and while young adults as having asthma., Aboriginal adults aged 65 years and older were excluded from this study to avoid the differential diagnosis bias, yet some amount of mislabeling appeared to still exist in the current study.

Similar to the results for children, the current study found that urban residence was a significant risk factor for all Aboriginal adult groups. Many studies have reported that urban/rural residence was associated with asthma, and rural residence was commonly tied to farming occupations or exposure to farming environments in previous studies (5, 114). As Aboriginal adults are not usually engaged in farming, it might not be the case. There might be other factors related to the differences between urban and rural settings, such as health care access and socio-economic status. For example, higher expenses in urban areas may prevent the residents with low socio-economic status from affording good-condition dwellings, and those people tend to suffer from moulds or other indoor allergens which are associated with asthma. The disparity of health care access and health education between rural and urban areas may also affect people's awareness of asthma and health care utilization for asthma. Additionally, heavier air pollution in urban areas may influence people's lung function and make people more prone to develop asthma.

Many studies have indicated a positive association between obesity and asthma with BMI being used to define overweight and obesity. The BMI at age 28 and weight gained after 18 years of age was reported as increasing the risk for asthma in a prospective study in the USA (95). In the current study, obesity was significantly associated with asthma in all Aboriginal groups except Inuit adults, and the odds ratios showed an increasing trend from under or normal weight, overweight, to obesity with only the odds ratio for obesity being statistically significant. Although some studies suggested there might be a gender effect on the association between obesity and asthma, there was no gender effect in the current study (97, 99).

Asthma is routinely described as an allergic disease, implying a strong relationship with allergy. Having allergic rhinitis or sensitization to common allergens was reported to be associated with a two-fold increase in the risk of developing asthma among adults aged 18 to 40 years in an Italian study (37). On the other hand, studies have indicated that atopy is more common seen in

childhood asthma compared to adult-onset asthma. Viral respiratory tract infections and occupations related to repeated exposures to cold air, cigarette, and chemicals were often found to be associated with adult-onset asthma (112). In the current study, allergy was significant in North American Indians and Inuit adults, but not in Métis and the multiple Aboriginal ancestries group. The directions of odds ratios were opposite between North American Indians and Inuit, with Allergy being a risk factor in North American Indian but a protective factor in Inuit. The 95% confidence intervals of the odds ratios were very wide, indicating the variance/sampling error was large. The estimates of the effect of allergy were unstable and depending on selected samples, so they might not be reliable. Other potential reasons include genetic and lifestyle factors; for instance, the protective effect in Inuit may result from allergen avoidance in some way. Also the type of allergy may be different in Inuit, since the question on allergy was not specific to allergens and the type of allergy could not be ascertained in this study. Further studies are required to elucidate the association in Inuit.

Difficulties in accessing heath care were positively associated with asthma in Aboriginal adults, except for those with Inuit ancestry. A study found that children who had more asthma-related primary care visits in the preceding year would have fewer emergency department visits for asthma in the following year, by reviewing claims in urban children with Medicaid insurance (117). The importance of primary care access for reducing the need of emergency care for asthma control was implied by the retrospective study. The Aboriginal population tended to have lower family income and lower education levels which might prevent them from accessing proper health care. Although Canada offers universal health care to ensure an equal right to access health care, such disparities may still exist. Difficulties in accessing to healthcare in the current study included the following reasons: no time to see a physician, unaffordable transportation to access health care, no health service providers in the neighborhood, and a lack of knowledge about how and where to seek medical care.

Although the smoking rate in Aboriginals was over 40%, about twice that in the general Canadian population, smoking habits were not significantly associated with ever asthma in Aboriginal adults in the current study. Contradictory results have been reported for the association between smoking and asthma for adults. Female smokers (aged 12 years and over) were found to have 1.7 times higher prevalence of asthma compared to female non-smokers in a Canadian study used the data from the National Population Health Survey 1994/1995 (65). On the other hand, no association between smoking and asthma was found in the residents of Saskatchewan (aged 20 to 65 years), although the association between wheezing and smoking was statistically significant (11). A study in the US also reported no differences in smoking rates between adults with and without asthma (68).

There was a difference between factors associated early and late onset of asthma in Aboriginal adults. In the current study, allergy was found to be significantly associated with early onset of asthma, but not with late onset of asthma. Previous studies have indicated atopy was more commonly seen in childhood asthma in comparison to adult-onset asthma (112). Intrinsic factors may be more likely to trigger the development of asthma in early ages so that early onset of asthma was more often seen in people with allergy. The relationships of obesity and early and late onset of asthma were opposite, where the association with obesity was significant only with late onset of asthma. BMI at age 28 years and weight gained after age 18 years were reported to be associated with asthma incidence in a 4-year follow-up study of female registered nurses in the United States (95), indicating the effect of obesity on asthma development in adulthood.

5.4. Strengths and Limitations

The sample of the 2006 Aboriginal Peoples Survey was selected across Canada and should be representative of the off-reserve Canadian Aboriginal population, providing researchers an excellent opportunity to investigate asthma epidemiology in off-reserve Canadian Aboriginals. The overall response rate was

80.1%, allowing the results to be generalized to the population at large. Additionally, the sample size of the APS 2006 was adequate to compare the prevalence and risk factors for asthma between Aboriginal groups. The current study also explored the risk factors for early and late onset of asthma in Aboriginal adults and suggested that the development of asthma might have different mechanisms between early and late onset.

Not surprisingly this study had limitations. The temporal sequence of exposures and outcomes were unclear due to the cross-sectional design of the 2006 APS, and causal relationships could not be determined. Besides that, the data were collected based on self-reports or proxy reports, less precise than objective measurements. For instance, using hospital charts or bronchial hyper-responsiveness tests to define asthma might be more accurate because people might not understand the definition of asthma and had over- or under-reported as having asthma. Although the questionnaires asked about physician-diagnosed asthma to minimize bias, there might still be recall bias when respondents answered the questionnaires about their medical history. Another example was the body mass index (BMI) derived from self-reported height and weight, which might be subject to recall and other bias. In addition, there were two administrative modes of data collection, personal and telephone interviews, in the 2006 APS. The two methods increased the response rate but the data collected by different administrative modes might be different in terms of quality and the validity.

Chapter 6 Conclusions

This study used the 2006 Aboriginal Peoples Survey to investigate the prevalence and risk factors of asthma in Canadian Aboriginals. The prevalence of ever asthma was 14.3% in children and 14.0% in adults, and the prevalence of current asthma was 5.7% in children. A rise of asthma prevalence in Canadian Aboriginals was seen when comparing to the results from the 2001 Aboriginal Peoples Survey. The risk factors for ever asthma in Aboriginal children included male sex, allergy, low birth weight, obesity, dwelling needing repairs and urban residence, and the factors of low income family, daycare attendance, and psychological/nervous difficulties were of borderline significance. Interactions were found between Aboriginal ancestry and sex as well as Aboriginal ancestry and allergy, respectively. The risk factors for current asthma in Aboriginal children were similar to those for ever asthma. In adults the risk factors for ever asthma were different between Aboriginal groups with the exception of urban residence which was common to all groups. Significant associations between ever asthma and obesity, female sex, and difficulties in accessing health care were found in adults of North American Indian, Métis, and multiple ancestries, but not of Inuit ancestry. Among all Aboriginal adult groups combines, allergy was associated with early onset of asthma, whereas obesity and low income were associated with late onset of asthma.

This study provided information about the epidemiology of asthma in the Canadian Aboriginal population at present and investigated the difference between Aboriginal groups. Both children and adults with Inuit ancestry were found to have a lower prevalence of asthma than other Aboriginal groups, which may be contributed to the different lifestyles and living environments of Inuit people, and further investigation is needed.

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Appendix I Letter of Ethical Approval

Re-Approval Form

Date:	May 3, 2010
Amendment/Renewal ID:	Pro00007573_REN1
Study ID:	MS1_Pro00007573
Study Title:	Prevalence and risk factors for asthma in non-reserve Aboriginal population
Principal Investigator:	Ambikaipakan Senthilselvan
Approval Expiry Date:	June 14, 2011

The Health Research Ethics Board - Health Panel has reviewed the renewal request and file for this project and found it to be acceptable within the limitations of human research.

The re-approval for the study as presented is valid for one year. It may be extended following completion of the annual renewal request before the approval expires. Beginning at 45 days prior to expiration, you will receive notices that the study is about to expire. Once the study has expired, you will have to resubmit. Any proposed changes to the study must be submitted to the Health REB for approval prior to implementation.

For studies where investigators must obtain informed consent, signed copies of the consent forms must be retained, as should all study related documents, so as to be available to the Health REB upon request. They should be kept for the duration of the project and for at least five (5) years following study completion.

Sincerely,

Glenn Griener, Ph.D.
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).