

Regional variations in risk factors for asthma in school children

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BACKGROUND: The authors have previously reported an increased prevalence of asthma in Estevan, Saskatchewan (21.4%) compared with Swift Current, Saskatchewan (16.2%).

OBJECTIVE: To determine the association between asthma and personal and indoor environmental risk factors in these communities.

METHODS: A population-based cross-sectional study was conducted in January 2000. A questionnaire was distributed to school children in grades 1 to 6 for completion by a parent. Multivariate logistic regression was used to examine associations between various risk factors and physician-diagnosed asthma.

RESULTS: Asthma was associated with respiratory allergy (adjusted OR [adjOR]=8.85, 95% CI 6.79 to 11.54), early respiratory illness (adjOR=2.81, 95% CI 1.96 to 4.03) and family history of asthma (adjOR=2.37, 95% CI 1.67 to 3.36). Several environmental factors varied with asthma by town. In Estevan, asthma was associated with home mould or dampness (adjOR=1.82, 95% CI 1.23 to 2.69) and was inversely associated with air conditioning (adjOR=0.56, 95% CI 0.37 to 0.85). The risk of asthma was increased if the child had previous exposure to environmental tobacco smoke from the mother in both communities (Swift Current: OR=1.87, 95% CI 1.06 to 3.30; Estevan: OR=2.00, 95% CI 1.17 to 3.43), and there was an inverse association with current exposure to environmental tobacco smoke from the mother in Estevan (OR=0.64, 95% CI 0.40 to 1.00). When multivariate analyses were stratified by sex, the relationship between home mould or dampness and asthma was most prominent in girls in Estevan. **CONCLUSIONS:** Despite a similar regional location, different risk factors for asthma were identified in each community. Local environmental factors are important to consider when interpreting findings and planning asthma care.

Key Words: Asthma; Children; Environmental tobacco smoke; Geographical differences; Home mould or dampness; Risk factors

Asthma is a multifactorial disease, which is known to be associated with both personal and environmental factors. However, these relationships have been inconsistent among studies. Reasons behind these inconsistencies could be due to differences in study method, but could also be due to differences in local factors. Geographical variation in asthma prevalence has been reported both among (1,2) and within countries (3,4). Several studies (4-9) have examined the risk factors for asthma in multiple communities, with overall associations being the major interest. Few studies (5,6), however, have

Les variations régionales des facteurs de risque d'asthme chez les enfants d'âge scolaire

HISTORIQUE : Les auteurs ont déjà rendu compte d'une prévalence d'asthme plus élevée à Estevan, en Saskatchewan (21,4 %) qu'à Swift Current, en Saskatchewan (16,2 %).

OBJECTIF : Déterminer l'association entre l'asthme et les facteurs de risque personnels et à l'intérieur du domicile au sein de ces collectivités.

MÉTHODOLOGIE : Une étude transversale en population générale a été menée en janvier 2000. Un questionnaire a été distribué à des enfants de 1^{re} à 6^e année afin que leurs parents le remplissent. La régression logistique multivariée a été utilisée pour examiner les liens entre divers facteurs de risque et l'asthme diagnostiqué par un médecin.

RÉSULTATS : L'asthme était associé à des allergies respiratoires (RR rajusté [RRR]=8,85, 95 % IC 6,79 à 11,54), à une maladie respiratoire précoce (RRR=2,81, 95 % IC 1,96 à 4,03) et à des antécédents familiaux d'asthme (RRR=2,37, 95 % IC 1,67 à 3,36). Plusieurs facteurs environnementaux de l'asthme variaient selon la ville. À Estevan, l'asthme était relié à des moisissures ou à une humidité à domicile (RRR=1,82, 95 % IC 1,23 à 2,69) et était inversement proportionnel à la climatisation (RRR=0,56, 95 % IC 0,37 à 0,85). Le risque d'asthme augmentait si l'enfant avait déjà été exposé à la fumée secondaire de la mère dans les deux collectivités (Swift Current : RR=1,87, 95 % IC 1,06 à 3,30; Estevan : RR=2,00, 95 % IC 1,17 à 3,43) et il existait un lien inversement proportionnel avec l'exposition courante à la fumée secondaire de la mère à Estevan (RR=0,64, 95 % IC 0,40 à 1,00). Lorsque les analyses multivariées étaient stratifiées selon le sexe, le lien entre les moisissures ou l'humidité à domicile et l'asthme dominait chez les fillettes d'Estevan.

CONCLUSIONS : Malgré un lieu géographique similaire, différents facteurs de risque d'asthme ont été repérés dans chaque collectivité. Il est important de tenir compte des facteurs environnementaux locaux au moment d'interpréter les observations et de planifier les soins de l'asthme.

considered the associations between various indoor exposures and asthma by community. The identification of community-specific exposures to environmental factors and their associations with asthma could lead to the better implementation of local programs to help reduce asthma morbidity.

In 2000, we conducted a survey of children's respiratory health in two communities located in southern Saskatchewan (Estevan and Swift Current), and reported a significantly higher prevalence of asthma in Estevan (21.4%) than in Swift Current (16.2%) (10). Girls in Estevan had a significantly higher asthma

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TABLE 1
Distribution of personal characteristics in the towns of
Swift Current and Estevan, Saskatchewan

	Swift Current (n=1077) (%)	Estevan (n=961) (%)	P
Caucasian	94.3	95.6	0.18
Parents with >high school education	63.3	58.0	0.01
Living in a two-parent home	84.3	88.0	0.02
Report of a respiratory allergy	27.6	27.5	0.96
Report of an early respiratory illness	11.8	9.6	0.11
Family history of asthma	11.7	11.0	0.64
Birthweight \geq 2500 g	93.9	93.2	0.60
Born premature	16.7	16.8	0.98
Breastfed	75.2	71.8	0.08
Mean \pm SD age (years)	8.74 \pm 1.76	8.68 \pm 1.78	0.52

prevalence than girls in Swift Current, and a similar prevalence to that of boys in Swift Current (10). These differences in asthma prevalence were not supported by differences in diagnostic labelling for asthma. The purpose of the current analysis was to investigate personal and indoor environmental characteristics in Swift Current and Estevan that may be associated with reported physician-diagnosed asthma in students in grades 1 to 6, and to examine whether these associations are different by town.

METHODS

This was a cross-sectional population-based study of school children. The method of data collection has been previously described (10). Briefly, questionnaires were distributed to parents of all children attending grades 1 to 6 in Estevan and Swift Current schools. Pulmonary function testing was completed in children attending grades 1 to 4 and has been reported elsewhere (10). Ethical approval was obtained from the Advisory Committee on Ethics in Biomedical Research at the University of Saskatchewan, Saskatoon, Saskatchewan. Local school and health boards in each community also approved the study. The present analysis is based on questionnaire data only.

Questionnaires

A standardized method was used to collect data by questionnaire from both communities during the same time periods. In January 2000, questionnaires were distributed through the schools (10). Questions were derived from the American Thoracic Society's Children's Respiratory Disease Questionnaire (11) and the Canadian Student Lung Health Study (3).

The questionnaires sought information regarding demographics, respiratory health, general health, family history of asthma and indoor exposures. 'Asthma' was defined by a positive response to the question, "Has this child ever been diagnosed as having asthma by a doctor?". 'Respiratory allergy' was assessed by at least one positive response to the question, "Has this child ever had an allergy (hives, runny nose, swelling, itchiness and/or wheezing) to any of the following: house dust; grain dust; pollen; trees; grasses; mould or mildew; dog; cat; and/or birds/feathers?". The child's exposure to environmental tobacco smoke (ETS) was based on the mother's and father's smoking histories, and was categorized as never exposed (absence of smoking during the subject's life), previously exposed (had smoked, but quit smoking since the subject's birth) and currently exposed

(currently smoking). The presence of mould or dampness in the home was assessed by a positive response to either the question, "Does your house have any damage caused by dampness (eg, wet spots on walls, floors)?", or the question, "Are there signs of mould or mildew in any living areas in your home?". Crowding was defined as the number of persons in the home divided by the number of rooms in the home. The proportion of life spent living in the current community was expressed as the number of years in the current location over age. Premature birth was defined as being born more than two weeks before the expected date. A history of early respiratory illness was considered to have occurred if there was a report of bronchitis, pneumonia, whooping cough or croup in the first two years of life. The type of dwelling was classified as single-family house or as other dwelling type, which included duplex, a more than two-family home and recreational vehicles, mobile homes and trailers.

Statistical analysis

All data were analyzed with the Statistical Package for the Social Sciences version 11.0 (SPSS Inc, USA). The prevalence of potential risk factors between the towns were compared using the χ^2 test for proportions between categorical variables, and the independent samples *t* test or Mann-Whitney test for continuous variables. Associations between asthma and various personal and indoor environmental characteristics were examined using a multivariate logistic regression model. Variables were included based on statistical significance, potential confounding and biological/clinical importance (12). The interaction between town and the other variables included in the main effects model was examined at the multivariate level. The OR and corresponding 95% CI of the main effects were then adjusted based on the interaction effect (12). Goodness of fit was tested using the Hosmer-Lemeshow test (12). Finally, multivariate analyses were conducted separately for boys and girls.

RESULTS

Participation in both communities was excellent; 88.9% in Swift Current and 94.2% in Estevan. The sex distribution was similar between Swift Current and Estevan (49.9% and 49.5% female, respectively). The prevalence of personal characteristics by town is presented in Table 1. A significantly higher proportion of children in Swift Current had a parent with more than a grade 12 education compared with children in Estevan, and a significantly lower proportion of children in Swift Current came from homes with two parents.

A significantly higher proportion of children in Estevan compared with Swift Current reported the presence of home mould or dampness, an air conditioner in the home, a dehumidifier in the home and gas heating (Table 2). A significantly lower proportion of children in Estevan reported the presence of a humidifier compared with Swift Current. The level of crowding and mean percentage of lifetime spent living in their present community was significantly greater in Estevan than in Swift Current.

Unadjusted analysis

The prevalence of asthma was significantly higher in Estevan compared with Swift Current (21.4% versus 16.2%, respectively, crude OR=1.41, 95% CI 1.13 to 1.76). When considering personal characteristics, there were significant associations between asthma and respiratory allergy, early respiratory illness and family history of asthma (Table 3). Indoor characteristics associated with asthma were previous exposure to ETS from the mother, home mould or dampness, and living in a dwelling other than a single-family house (Table 4).

TABLE 2
Distribution of indoor environmental characteristics in the towns of Swift Current and Estevan, Saskatchewan

	Swift Current (n=1077) (%)	Estevan (n=961) (%)	P
ETS exposure from the mother			
Never	59.8	58.7	
Previous	10.8	12.1	
Current	29.4	29.2	0.65
ETS exposure from the father			
Never	57.6	52.2	
Previous	11.1	13.0	
Current	31.3	34.8	0.05
Urban residence	94.4	95.0	0.56
Presence of home mould or dampness	19.8	26.7	<0.001
Ever owned a pet	66.9	64.1	0.19
Presence of a home air conditioner	48.4	76.1	<0.001
Presence of a home air filter	29.0	30.9	0.34
Presence of a home humidifier	30.5	26.2	0.04
Presence of a home dehumidifier	5.1	9.6	<0.001
Presence of a home fireplace	30.0	29.6	0.72
Gas heating	86.8	91.2	<0.01
Electrical heating	8.0	7.7	0.81
Single-family house	88.1	86.1	0.17
Mean ± SD crowding	0.65±0.27	0.67±0.28	0.05
Mean ± SD % time spent in location	0.79±0.32	0.84±0.30	<0.01

ETS Environmental tobacco smoke

When associations with asthma were examined in each town at the univariate level, associations similar to the overall findings for asthma were found for respiratory allergy, early respiratory illness, family history of asthma and previous exposure to ETS from the mother in both communities. However, the towns differed in certain exposures for asthma. In Swift Current, associations with asthma were found for those of a non-Caucasian ethnicity (OR=2.88, 95% CI 1.03 to 8.05) and gas heating in the home (OR=1.75, 95% CI 1.00 to 3.07). In Estevan, associations were found between asthma and prior exposure to ETS from the father (OR=1.67, 95% CI 1.07 to 2.60), the presence of home mould or dampness (OR=1.96, 95% CI 1.41 to 2.72), the presence of air conditioning (OR=0.57, 95% CI 0.41 to 0.80), and the presence of a fireplace (OR=0.69, 95% CI 0.48 to 0.99).

Multivariate analyses

In addition to the variable indicating the two communities, other risk factors were included in a multivariate logistic regression (change in $-2 \log$ likelihood = 444.90, degrees of freedom = 18, $P < 0.001$). The strongest risk factor for asthma was the reporting of a respiratory allergy (OR=8.85, 95% CI 6.79 to 11.54). A history of early respiratory illness (OR=2.81, 95% CI 1.96 to 4.03) and a family history of asthma (OR=2.37, 95% CI 1.67 to 3.36) were also associated with asthma.

A significant effect modification was present between town and some household characteristics (Figure 1). In Estevan, the presence of home mould or dampness was associated with an increased risk of asthma (OR=1.82, 95% CI 1.23 to 2.69) and an inverse association with the presence of an air conditioner (OR=0.56, 95% CI 0.37 to 0.85). These associations were not significant in Swift Current. Although there was an increased

TABLE 3
Distribution of personal characteristics by asthma

	No asthma (n=1657), n (%)	Asthma (n=381), n (%)	OR (95% CI)
Ethnic background			
Non-Caucasian	88 (5.3)	15 (3.9)	
Caucasian	1569 (94.7)	366 (96.1)	1.37 (0.78–2.39)
Parents with >high school education			
No	655 (39.5)	144 (37.8)	
Yes	1002 (60.5)	237 (62.2)	1.08 (0.86–1.35)
Living in a two-parent home			
No	229 (13.8)	55 (14.4)	
Yes	1428 (86.2)	326 (85.6)	0.95 (0.69–1.31)
Report of respiratory allergy			
No	1351 (81.5)	126 (33.1)	
Yes	306 (18.5)	255 (66.9)	8.94 (6.98–11.44)
Report of early respiratory illness			
No	1522 (91.9)	297 (78.0)	
Yes	135 (8.1)	84 (22.0)	3.19 (2.36–4.30)
Family history of asthma			
No	1512 (91.2)	294 (77.2)	
Yes	145 (8.8)	87 (22.8)	3.09 (2.30–4.14)
Birthweight			
≥2500 g	1552 (93.7)	355 (93.2)	
<2500 g	105 (6.3)	26 (6.8)	1.08 (0.69–1.69)
Born premature			
No	1388 (83.8)	309 (81.1)	
Yes	269 (16.2)	72 (18.9)	1.20 (0.90–1.60)
Breastfed			
No	441 (26.6)	97 (25.5)	
Yes	1216 (73.4)	284 (74.5)	1.06 (0.82–1.37)
Mean ± SD age (years)	8.7±1.8	8.8±1.7	1.02 (0.96–1.08)

risk of asthma in both communities if the child had previous ETS exposure from the mother (Swift Current: OR=1.87, 95% CI 1.06 to 3.30; Estevan: OR=2.00, 95% CI 1.17 to 3.43), there was an inverse association between asthma and current ETS exposure in Estevan that was borderline significant (OR=0.64, 95% CI 0.40 to 1.00), and there was no significant association between asthma and mother's current smoking in Swift Current.

Stratified analysis by sex

The final multivariate model was fitted separately for boys and girls (Table 5). In both boys and girls, respiratory allergy, family history of asthma and early childhood respiratory illness were associated with asthma. The association between asthma and past ETS exposure from the mother was significant in boys. In girls, the association between rural living and asthma was significant. Also in girls, the association between asthma and home mould or dampness was significant between towns, with girls showing a significant increase in the risk of asthma with the report of home mould or dampness in Estevan but not Swift Current.

DISCUSSION

The results of our study confirm previously identified associations between personal characteristics and asthma, and also highlight the need to interpret associations between asthma and indoor environmental characteristics at a local level. In the present study, respiratory allergy was most strongly associated

TABLE 4
Distribution of indoor environmental factors by asthma

	No asthma (n=1657), n (%)	Asthma (n=381), n (%)	OR (95% CI)
ETS exposure from mother			
Never	997 (60.2)	211 (55.4)	
Previous	166 (10.0)	66 (17.3)	1.87 (1.36–2.59)
Current	494 (29.8)	104 (27.3)	1.00 (0.77–1.29)
ETS exposure from father			
Never	920 (55.5)	202 (53.0)	
Previous	189 (11.4)	56 (14.7)	1.35 (0.97–1.89)
Current	548 (33.1)	123 (32.3)	1.02 (0.80–1.31)
Residence			
Urban	1574 (95.0)	356 (93.4)	
Rural	83 (5.0)	25 (6.6)	1.33 (0.84–2.11)
Presence of home mould or dampness			
No	1300 (78.5)	268 (70.3)	
Yes	357 (21.5)	113 (29.7)	1.54 (1.20–1.97)
Ever owned a pet			
No	576 (34.8)	126 (33.1)	
Yes	1081 (65.2)	255 (66.9)	1.08 (0.85–1.37)
Presence of a home air conditioner			
No	629 (38.0)	157 (41.2)	
Yes	1028 (62.0)	224 (58.8)	0.87 (0.70–1.10)
Presence of a home air filter			
No	1169 (70.5)	260 (68.2)	
Yes	488 (29.5)	121 (31.8)	1.12 (0.88–1.42)
Presence of a home humidifier			
No	1182 (71.3)	276 (72.4)	
Yes	475 (28.7)	105 (27.6)	0.95 (0.74–1.21)
Presence of a home dehumidifier			
No	1539 (92.9)	352 (92.4)	
Yes	118 (7.1)	29 (7.6)	1.08 (0.70–1.64)
Presence of a home fireplace			
No	1145 (69.1)	283 (74.3)	
Yes	512 (30.9)	98 (25.7)	0.77 (0.60–1.00)
Gas heating			
No	191 (11.5)	36 (9.4)	
Yes	1466 (88.5)	345 (90.6)	1.25 (0.86–1.82)
Electrical heating			
No	1522 (91.9)	356 (93.4)	
Yes	135 (8.1)	25 (6.6)	0.79 (0.51–1.23)
Type of dwelling			
Single-family house	1459 (88.1)	317 (83.2)	
Other dwelling type	198 (11.9)	64 (16.8)	1.49 (1.10–2.02)
Mean \pm SD crowding	0.66 \pm 0.28	0.66 \pm 0.28	0.94 (0.63–1.42)
Mean \pm SD % time spent in location	0.81 \pm 0.30	0.82 \pm 0.30	1.11 (0.76–1.61)

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with asthma. Similarly, strong associations between allergy and asthma have been seen in other studies (13,14). Our study also supports previous studies (5,15-19) showing that having at least one parent with asthma increases a child's risk of developing asthma. Whereas other studies report inconsistent associations between early respiratory illnesses and asthma, our findings of an association were consistent between communities.

We found that despite being in a similar geographical setting, the two study communities differed in their association between environmental characteristics and asthma. Although there was an increased risk of asthma associated with previous

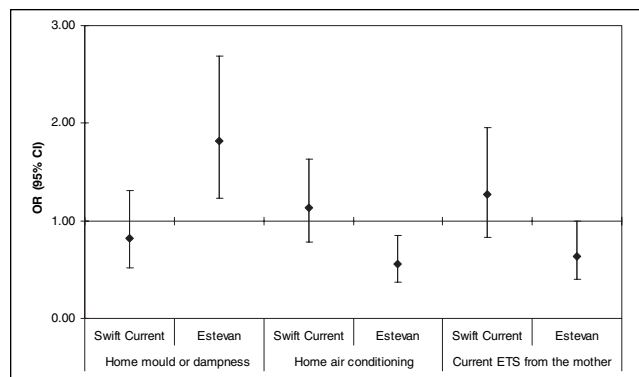


Figure 1) Adjusted ORs between asthma and home mould or dampness, home air conditioning and current exposure to environmental tobacco smoke (ETS) from the mother. ORs have been adjusted for town (Estevan or Swift Current, Saskatchewan), age, sex, respiratory allergy, early respiratory illness, family history of asthma, ETS exposure from the mother, ETS exposure from the father, urban residence, home mould or dampness, air conditioning, home type and interaction terms by town by home mould or dampness, town by air conditioning, town by ETS exposure from the mother and town by home type

ETS exposure from the mother in both communities, associations between current ETS exposure from the mother and asthma differed between communities, with no association in Swift Current and an inverse association in Estevan. Several studies and reviews (8,14,20-25) have shown that parental smoking, especially maternal smoking, is associated with asthma or asthma symptoms. Our findings for current ETS exposure are difficult to interpret. It is possible that many of the mothers quit smoking as a result of their child's asthma diagnosis, or those who are currently smoking may be smoking outside of the child's environment, resulting in no relationship or inverse associations with asthma. More information about the nature of current smoking patterns of parents is required.

In Estevan, but not in Swift Current, the presence of home mould or dampness was associated with an increased risk of asthma. The strength of the association in Estevan was consistent with other studies involving children, which generally show positive associations with mould and/or dampness (8,9,26,27), with ORs of approximately 2.00 (27). Differences in the results between previously conducted studies may be attributed to the differences in definitions and methods used to assess exposure to home mould or dampness. Home air conditioning in Estevan was inversely associated with asthma. Previous studies (7,28,29) have shown conflicting results of associations between asthma symptoms and the use of air conditioners. The mechanisms relating use of air conditioners and asthma are not known. Because of the general problems with outdoor dust in Estevan, with agricultural practices and nearby strip coal mining, it is possible that air conditioners are used to control the quality of the indoor environment of homes. More specific information regarding the type, location, frequency of cleaning, or reasons for the use of air conditioners would assist in identifying reasons for this observed association.

In the sex-stratified analysis, similar associations between asthma and risk factors were similar for both boys and girls; however, levels of significance were not met for the associations between mould or dampness and asthma in boys, and for previous ETS exposure from the mother in girls. The lack of statistical

TABLE 5
Multivariate logistic regression model of risk factors for asthma stratified by sex

	Boys (n=1025)		Girls (n=1013)	
	OR (95% CI)	P	OR (95% CI)	P
Age	0.97 (0.88–1.07)	0.49	0.97 (0.86–1.09)	0.57
Respiratory allergy				
Absent	1.00		1.00	
Present	8.28 (5.83–11.76)	<0.001	9.43 (6.28–14.17)	<0.001
Early childhood respiratory illness				
Absent	1.00		1.00	
Present	2.31 (1.43–3.72)	0.001	3.28 (1.89–5.68)	<0.001
Family history of asthma				
Absent	1.00		1.00	
Present	2.73 (1.68–4.44)	<0.001	2.03 (1.22–3.38)	0.006
ETS exposure from the mother				
None	1.00		1.00	
Past	2.04 (1.19–3.50)	0.01	1.76 (0.97–3.20)	0.06
Current	0.98 (0.64–1.50)	0.87	0.84 (0.51–1.38)	0.50
ETS exposure from the father				
None	1.00		1.00	
Past	1.10 (0.62–1.94)	0.75	1.15 (0.61–2.14)	0.67
Current	0.94 (0.62–1.41)	0.75	0.85 (0.53–1.37)	0.51
Residence				
Urban	1.00		1.00	
Rural	0.84 (0.35–2.02)	0.70	2.91 (1.44–5.90)	0.003
Air conditioning				
Absent	1.00		1.00	
Present	0.75 (0.52–1.10)	0.14	0.95 (0.62–1.45)	0.95
Dwelling type				
Single-family house	1.00		1.00	
Other dwelling type	1.16 (0.70–1.92)	0.57	1.53 (0.88–2.67)	0.13
Home mould or dampness				
Swift Current (absent)	1.00		1.00	
Swift Current (present)	0.97 (0.53–1.79)	>0.05	0.64 (0.31–1.31)	>0.05
Estevan (present)	1.70 (0.98–2.94)	>0.05	1.76 (1.01–3.07)	<0.05

Adjusted for all of the variables in the model, town (Estevan or Swift Current, Saskatchewan) and interaction terms for home mould or dampness by town. ETS Environmental tobacco smoke

significance may be due to reduced sample size in the stratified analysis because the patterns and strength of associations were similar between boys and girls. A notable difference, however, was the significant association between rural living and asthma in girls. This finding for girls contradicts the more common pattern of reduced risk of asthma in rural settings such as farms (30). Reasons for this finding could not be determined from the present study. Future investigations should consider sex when investigating rural exposures.

Several studies (4-9) have investigated risk factors associated with asthma in multiple locations. However, only a few of these considered risk factors by community (5,6). Although the inclusion of several communities in an analysis aids in examining determinants of asthma in general, assessment of exposures at the local level is important for both the etiological understanding of asthma and the application of interventions.

Hessel et al (5) and Duhme et al (6) have shown that environmental factors are not consistently associated with asthma across different locations within the same study. Although our study supports this, some of the significant associations between asthma and environmental factors differed between our study and that of Hessel et al (5) and Duhme et al (6). These inconsistencies could be due to differences in methods or variations in settings.

Hessel et al (5) conducted a cross-sectional study followed by a case-control study in two Canadian communities from a similar region. A stratified, multivariate analysis showed differences in the association between various risk factors and asthma between communities. Although Hessel et al (5) focused on a sample of the population, we were able to approach all eligible school children within each study community, and experienced excellent participation rates from both communities. In addition, our study focused on a narrower age range (six to 13 years) compared with the study by Hessel et al (5) (five to 19 years), which could reduce potential confounding factors such as a personal smoking history with older children. In a cross-sectional study by Duhme et al (6) in Germany, associations with asthma were studied in two communities with differences in the associations between communities being seen for five- to eight-year-old children; however, the two communities being compared were from different regions (one was a coastal city and the other was an inland city).

Although the communities we studied were both in the southern region of Saskatchewan and had many similarities in size and industry, some differences may have influenced the findings. The area surrounding Estevan is the site of strip mining for coal and coal-fired power plants. Air quality measurements were available in Estevan; however, they were not available in Swift Current

and, therefore, could not be used in the present study. Estevan averages more annual rainfall than Swift Current (333.1 mm versus 265.2 mm, respectively) (31), and has a lower unemployment rate than Swift Current (2.2% versus 3.8%), although both communities are below the Canadian unemployment rate (32).

One limitation of our study is that no objective measures of exposure were collected. However, our definitions of exposures (eg, previous ETS exposure and current ETS exposure from maternal and paternal sources) are similar to those used in other epidemiological studies of risk factors for asthma, and our findings, for the most part, are consistent with those of other studies.

CONCLUSIONS

We found that the prevalence of exposures and the associations between asthma and some indoor environmental exposures differed between two communities within the southern region of Saskatchewan. We have provided further evidence that exposure to ETS in children is important when considering asthma. We have also shown that other indoor environmental characteristics, such as home mould or dampness, are important but may be most significant at a local level. Finally, we have shown that although

risk factors for asthma are generally similar in boys and girls, there are potential differences. Future considerations in studies of regional variation in asthma should include monitoring of the ambient outdoor environment, and objective measures of the indoor environmental factors within communities. Additionally, the differential effects of various exposures on boys and girls should be investigated. Despite some limitations, our study was population-based, with both communities having excellent participation rates and using identical questionnaires and design, including the dates of data collection. Results of the present study provide evidence that development of asthma programs will need to consider characteristics specific to the respective communities.

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