Respiratory symptoms and asthma in two farming populations: A comparison of Hutterite and non-Hutterite children

Donna C Rennie RN PhD[1,2], James Dosman MD FRCPC[1,3], Ambikaipakan Senthilselvan PhD[4]

DC Rennie, J Dosman, A Senthilselvan. Respiratory symptoms and asthma in two farming populations: A comparison of Hutterite and Non-Hutterite children. Can Respir J 2002;9(5):313-318.

OBJECTIVE: To determine the prevalence of asthma and respiratory symptoms in a farming population of Hutterite and non-Hutterite children.
PARTICIPANTS AND SETTING: A population of 830 school-age, farm-dwelling children in rural Saskatchewan that included 83 children residing in Hutterite farming colonies.
METHODS: A cross-sectional survey questionnaire was sent to parents of children attending grades 1 to 5 in schools within a grain-growing and mixed-farming region of central Saskatchewan. The questionnaire was used to identify respiratory symptoms, environmental and host characteristics, and reported doctor-diagnosed asthma.
RESULTS: The prevalence of asthma in Hutterite children was 2.4% compared with 9.2% in non-Hutterite children. While Hutterite children did not differ from their farming counterparts with regard to the frequency of reported respiratory allergies, they were less likely to be exposed to cigarette smoke and to participate in farm-related activities. In the multivariate analysis, being Hutterite continued to be protective for asthma (odds ratio 0.21; 95% CI 0.05 to 0.89).
CONCLUSION: The observed lower rate of asthma in Hutterite children than in non-Hutterite children may be related to both genetic factors and differences in farming and household factors between the two groups.

Key Words: *Asthma; Children; Farming; Hutterite*

Les symptômes respiratoires et l'asthme dans deux populations agricoles : Une comparaison entre les enfants huttériens et non-huttériens

OBJECTIF : Déterminer la prévalence de l'asthme et des symptômes respiratoires dans une population agricole d'enfants huttériens et non-huttériens.
PARTICIPANTS ET LIEU : Population de 830 enfants d'âge scolaire de la Saskatchewan rurale habitant en milieu agricole, dont 83 enfants vivant dans des colonies agricoles huttériennes.

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[1]*Institute of Agricultural, Rural and Environmental Health,* [2]*College of Nursing, and* [3]*Department of Medicine, University of Saskatchewan, Saskatoon, Saskatchewan;* [4]*Department of Public Health Sciences, University of Alberta, Edmonton, Alberta*
Correspondence and reprints: Dr D Rennie, Institute of Agricultural, Rural and Environmental Health, University of Saskatchewan, 103 Hospital Drive, Royal University Hospital, Saskatoon, Saskatchewan S7N 0W8. Telephone 306-966-7886, fax 306-966-8799, e-mail rennied@sask.usask.ca

MÉTHODOLOGIE : Un questionnaire transversal a été posté aux parents d'enfants de première à cinquième année d'écoles d'une région céréalière et de polyculture du centre de la Saskatchewan. Le questionnaire a permis de repérer les symptômes respiratoires, les caractéristiques environnementales et de l'hôte, de même que les cas d'asthme diagnostiqués par un médecin.

RÉSULTATS : La prévalence d'asthme chez les enfants huttériens était de 2,4 %, par rapport à 9,2 % chez les enfants non-huttériens. Bien que la fréquence d'allergies respiratoires déclarées n'aient pas différé chez les enfants huttériens par rapport aux autres enfants de milieu agricole, les enfants huttériens étaient moins susceptibles d'être exposés à la fumée de cigarette et de participer aux activités agricoles. Dans l'analyse multivariée, le fait d'être Huttérien continuait de constituer un facteur de protection contre l'asthme (risque relatif 0,21; IC 95 % 0,05 à 0,89).

CONCLUSION : Le taux moins élevé d'asthme observé chez les enfants huttériens par rapport aux enfants non-huttériens peut être relié à la fois à des facteurs génétiques et à des différences dans les modes agricoles et les habitudes familiales des deux groupes.

Persons living in Hutterite colonies are known for their communal lifestyle that is deeply rooted in farming and rural living. Hutterites are members of an Anabaptist group that migrated to Canada from Europe in the early 1900s and settled primarily in the Canadian prairie provinces and Northern Great Plains of the United States (1). There are three distinct sects or leutes of Hutterites found in Canada, including the Dariusleut, Lehrerleut and Schmiedeleut. Of these three leutes, only the Dariusleut and Lehrerleut sects are located in Saskatchewan (1). Living in rural communal environments, Hutterites have remained genetically isolated from other rural and urban groups, preferring to marry between colonies and within sects. The endogamous behaviour of their culture has allowed the study of the transmission patterns of various inherited traits (2,3), the assessment of chronic illness patterns (4-8) and the investigation of inherited conditions (9,10). The expression of asthma within a population requires both a genetic predisposition and exposure to environmental factors such as allergens and irritants (11,12). Limited information is available regarding the prevalence of childhood asthma, acute respiratory symptoms and associated factors within Hutterite populations. While the occurence of asthma and atopy appears to be lower in rural and farm-dwelling children than in their urban or nonfarming counterparts (13-16), there is limited information about the nature of asthma within different farming populations. As part of a larger study of childhood asthma in a rural region of Saskatchewan, the present subanalysis examined the relationship between childhood asthma, and Hutterite and non-Hutterite living.

PARTICIPANTS AND METHODS

A cross-sectional survey approach was used to assess the respiratory health of a cohort of 2457 school-age children living in the west-central region of Saskatchewan in December 1993. The overall methodology for this study has been reported elsewhere (17). Briefly, a self-administered questionnaire was sent through the schools to parents of children attending grades 1 to 5. Visits were made to all 43 school sites to distribute and collect questionnaires. Permission for the study was obtained from school divisions in the study area and from senior pastors at the 10 Hutterite colony sites in the study area. The overall response rate to the survey was 80%. The present analysis is based on the responses to the questionnaire for the 830 children who lived on farms or acreages in the region of the study area that included the 10 Hutterite colonies.

Asthma was defined as a positive response to the question: Has the child ever been diagnosed as having asthma by a doctor or at a hospital? This question has demonstrated good sensitivity for childhood asthma as identified by a 20% drop in forced expiratory volume in 1 s following less than 7.8 μmol of inhaled histamine (18), and has shown good reliability (k=0.77) on repeated questionnaire reporting by parents (19). Respiratory symptoms including nocturnal cough, production of phlegm and wheeze not associated with asthma or colds were also assessed. Allergy was considered to be present if there was a report of the child being allergic to house dust, grain dust, pollen, trees, mold, grasses, dogs, cats, birds or farm animals. Parental atopy status was determined from a history of asthma, allergy or hay fever in either of the child's natural parents. A variety of household environmental characteristics were examined, including a history of parental smoking since the child's birth (passive smoking), signs of damage in the home caused by dampness (home dampness), type of home dwelling (single family home or other), presence of a cat or dog in the home (pet) and use of natural gas heating. The farm environmental characteristics explored included type of agricultural production on farms (grain, fruit and vegetable, poultry, swine and beef) and participation of more than 1 h at a time in the past year in or near any of the following farm-related activities. These activities included cleaning pens, haying, harvesting, moving or playing in hay bales, cleaning or playing in barns, feeding livestock or poultry, emptying or filling grain bins, grooming or playing with animals, or pouring or mixing farm chemicals. It was also determined if the child had a previous history of an overnight stay in a hospital (ever hospitalized) or a history in the past year of one or more absences from school because of an illness lasting one week or more. Ethical consent for this study was received from the University of Saskatchewan Advisory Committee on Ethics in Human Experimentation.

Data analyses were conducted using SPSS for Windows (release 9.0, SPSS Inc, USA). After assessing homogeneity within the Hutterite population by comparing hospitalization patterns, and host and environmental variables between sects, the differences in host and environmental factors between Hutterite and non-Hutterite groups were examined using the χ^2 test for proportions and the *t* test sta-

TABLE 1
A Comparison of host and environmental characteristics of Hutterite and other farm children participating in a study of respiratory and asthma symptoms

Characteristic	Hutterite (n=83)	Non-Hutterite (n=747)	Total (n=830)
		mean ± SD	mean ± SD
Age (mean ± SD)	8.5±1.59	8.1±1.48*	8.1±1.49
Persons in home† (mean ± SD)	7.8±2.46	5.2±1.59	5.5±1.85
Sex			
Male	43 (51.8)	400 (53.5)	443 (54.4)
Female	40 (48.2)	347 (46.5)	387 (46.6)
Allergy	15 (18.1)	191 (25.6)	168 (20.2)
Parental atopy	16 (19.3)	333 (44.6)†	349 (42.0)
Ever hospitalized	32 (38.6)	286 (38.3)	318 (38.3)
School absences >1 week	2 (2.4)	84 (11.2)†	86 (10.4)
Passive smoking	–	257 (34.4)†	257 (31.0)
Single family housing	3 (3.6)	676 (90.5)†	679 (81.8)
Natural gas heating	28 (33.7)	361 (48.3)*	389 (46.9)
Home dampness	2 (2.4)	245 (32.8)†	247 (29.8)
Pet in the home	–	215 (28.8)†	215 (25.9)
Farming activities	26 (31.3)	390 (52.2)†	416 (50.1)

**P<0.05; †P<0.001. Age and persons in home are expressed as (mean ± SD) all other characteristics are expressed as n (%)*

tistics. The association between being Hutterite and non-Hutterite, and asthma or wheeze was examined at the multivariate level using logistic regression and controlling for potential covariates, including age, sex, home dampness, passive smoking, pets and farming activities. The level of significance for all statistical tests was set at α=0.05.

RESULTS

The overall response rate to the main survey was 80%. Of the 1015 children in the study reported to live in farming environments, 830 children resided in the region of the Hutterite colonies, and of these children, 83 (10%) were residents of Hutterite colonies. The response rate for the non-Hutterite population could not be determined because farm residence information was available only on the questionnaire and not on the school lists used to determine response rates. However, this information was available for all Hutterite students because their schools were situated in Hutterite colonies, and it could be determined that 98.9% of Hutterite children returned questionnaires. When Hutterite sects or leutes were compared for host and environmental characteristics, there were no differences for age, sex and environmental factors, including housing, type of heating and types of farm production. Between sects, children from the Lehrerleut sect were more likely to have been hospitalized in the past (52.9% of Lehrerleut children versus 28.6% of Dariusleut children; χ^2=5.03, degrees of freedom=1, P<0.05).

TABLE 2
Proportion of Hutterite and non-Hutterite farm children playing near or participating in farming activities for more than 1 h at a time in the past 12 months

Farming activity	Hutterite (n=83) (%)	Non-Hutterite (n=747) (%)	P
Harvesting	45.8	71.9	<0.001
Emptying or filling grain bins	14.5	36.8	<0.001
Haying	19.3	32.8	0.01
Moving or playing with bales	34.9	38.2	<0.001
Feeding livestock or poultry	43.4	43.4	1
Cleaning or playing in barns	48.2	45.8	0.68
Cleaning pens	19.3	20.7	0.89
Grooming or playing with animals	43.4	74.7	<0.001
Pouring or mixing farm chemicals	3.6	1.1	0.09*

**Fisher's exact test*

Table 1 presents a comparison of host and environmental variables between Hutterite and non-Hutterite children. Overall, the groups did not differ significantly from one another for ever being hospitalized. Hutterite children were less likely to have missed more than one week of school compared with non-Hutterite children. The overall prevalence of allergy was 20.2%. Non-Hutterite children had a higher prevalence of allergy (25.6% versus 18.1%), although differences were not statistically significant. Larger differences were seen for parental atopy, with more than twice the prevalence of parental atopy reported for non-Hutterite children. Hutterite children were more likely to live in multiple family dwelling units and with larger families, and they were less likely to be exposed to homes with signs of dampness or those heated with natural gas. Hutterite children did not have pets and were not exposed to smoking in the home.

Farm production activities and farm-related exposures of children differed between Hutterite and non-Hutterite groups. Huttterite children were more likely to have all types of production on their farms, including grain, poultry, beef, swine, and/or fruit and vegetables (P<0.01). The most frequent type of farm production for non-Hutterite children was grain (88.1% of non-Hutterite children). When the participation of children in any farm-related activity in the past year was examined, it was found that Hutterite children were less likely to participate in any farming activities compared with other farm children (Table 1). When the specific farming activities of the groups were examined, non-Hutterite farm children were more likely to participate in or play near harvesting activities, emptying or filling of grain bins, haying activities, hay bales, and grooming or playing with animals. Hutterite children did not differ from non-Hutterite children in their participation near or in feeding livestock or poultry, cleaning or playing in barns, cleaning pens or the pouring of farm chemicals (Table 2).

Table 3 describes the prevalence of asthma and wheeze in Hutterite and non-Hutterite children. The overall

TABLE 3
Univariate analysis of selected respiratory symptoms and asthma for Hutterite and non-Hutterite farm children

Respiratory symptoms	Hutterite (n=83), n (%)	Non-Hutterite (n=747), n (%)
Cough on waking	6 (7.2)	68 (9.1)
Wheeze/no asthma	3 (3.6)	76 (10.2)*
Wheeze on exercise	3 (3.6)	53 (7.1)
Asthma	2 (2.4)	69 (9.2)†

**χ^2=3.73, degrees of freedom=1, P=0.05; †χ^2=4.45, degrees of freedom=1, P=0.04*

TABLE 4
Adjusted odds ratios and 95% CI for childhood asthma, and Hutterite and non-Hutterite living

Variables	Adjusted odds ratio	95% CI
Hutterite (referent non-Hutterite)	0.21	0.05 to 0.90
Home dampness	0.81	0.47 to 1.40
Age	1.01	0.85 to 1.19
Sex (referent male)	0.38	0.22 to 0.67
Passive smoking	1.02	0.60 to 1.75
Pet living in home	0.8	0.44 to 1.45
Participation in farming activities	0.76	0.36 to 1.62

prevalence of asthma in the Hutterite study population was significantly lower than that found in the non-Hutterite population (2.4% and 9.2%, respectively). The two Hutterite children with physician-diagnosed asthma each resided in different Hutterite sects. Hutterite children had proportionately less wheeze than non-Hutterite children. The groups did not differ for wheeze on exercise, cough on waking or a history of reported respiratory allergies, although there was a trend toward less reporting of these symptoms for Hutterite children.

Table 4 presents the results of the multivariate analysis for associations between asthma and Hutterite living. After controlling for potential confounders, including age, sex, dampness, presence of pets in the home, passive smoking and participation in farming activities, it was found that living on a Hutterite farm continued to be associated with less asthma (odds ratio 0.21; 95% CI 0.05 to 0.90), but was no longer found to be associated with wheeze (odds ratio 0.48; 95% CI 0.14 to 1.62).

DISCUSSION

The results of the present analysis, comparing Hutterite and non-Hutterite children for asthma and associated environmental factors, identified a lower prevalence of asthma in children living on Hutterite farms, and showed that certain environmental factors often associated with asthma in children were not reported to be present in the immediate environment of Hutterite children. Indoor exposures such as the presence of pets and passive smoking previously documented by others (20-23) as being associated with asthma were reportedly absent in the immediate environment of Hutterite children. As well, Hutterite children were identified as having limited exposure to farm-related activities. These findings suggest that an inherited propensity for asthma combined with a founder effect in an endogamous population (24) could be important in the low prevalence of asthma seen in the Hutterite study population. Thus, the combination of both limited familial history of atopy and absence of asthmogenic environmental factors may have contributed to the low prevalence of asthma in the Hutterite group.

Others have reported lower occurrences of diseases in Hutterite populations than in non-Hutterite populations. Ross et al (6) found that Hutterite brethren had significantly less occurrence of varicella-zoster and herpes zoster viruses compared with age-, sex- and region-matched controls (P<0.001). Hader et al (8) examined the frequency of the occurrence of multiple sclerosis in Northwestern United States and Western Canada, typically regions with a high rate of occurrence, and found that the Hutterite population had a much lower occurrence of multiple sclerosis (28/100,000 population compared with an expected rate of 100 to 220/100,000 population). As with asthma, it is unclear how the environment and genetic characteristics of Hutterite people modulate the limited expression of these conditions.

The finding of a 9.2% prevalence of asthma in non-Hutterite children is higher than what has been reported by Ernst and Cormier (5.1%) (14) in an adolescent population of farm children in Canada. The prevalence of asthma in Hutterite children resembles the current findings for European farm children (15,16). Reidler et al (15) reported an asthma prevalence of 1.1% in Austrian farm children aged eight to 10 years, while von Ehrenstein et al (16) found the prevalence of asthma to be 3.4% in their study of Swiss farm children aged five to seven years. As in the studies by Reidler et al (15) and von Ehrenstein et al (16), our study population of Hutterite children was more likely to live on farms where livestock production was common. von Ehrenstein and colleagues (16) found that livestock farming was associated with a report of decreased atopy (hay fever, asthma and/or eczema) in farm-dwelling children. Although Hutterite children appeared to participate less in grain-related farming activities (haying, harvesting, filling and emptying grain bins), Hutterite and non-Hutterite children did not differ in their participation in livestock-related activities (cleaning pens and barns, and feeding animals) or reported allergies. However, because we did not assess farm-related exposures in early life, when exposure to such activities are thought to be more critical for the later development of asthma (14,15), we cannot be confident that current participation patterns reflect those occurring earlier in life. In the present study, the overall prevalence of reported allergy was low compared with that

reported by Ernst and Cormier (14), who found that the prevalence of atopy, as identified by skin-prick testing, was 40.8% in farm children. Our finding of a prevalence of allergy of 20.2% in farm children is similar to the findings of European studies of children (15,16). The use of allergy testing to verify reports of atopy in children participating in the present study could have produced a more useful comparison of our findings with previously reported studies of farm children.

Sporik et al (25) have suggested that early, high level exposures around two years of age to allergens in potentially allergic children could lead to the development of asthma in later childhood. In the case of children living in Hutterite colonies, early, regular exposures to farm activities may be less likely to occur than in the case of other farm children. We did not identify the age at which children in the study began their early participation in farming activities. However, it is generally known that communal daycare settings for preschool and young school-age children are common practice in Hutterite colonies (1). Daycare generally lasts until the end of early school years (grades 5 to 6). While this practice was primarily used to instill the early sense of community in children (1), in a serendipitous manner, the practice can limit early exposure to the occupational environments on farms that are known to be sources of respiratory problems in adults (26). It is possible that by attending a communal daycare setting at an early age and continuing through the early school years, Hutterite populations in Saskatchewan may limit the frequency of exposures to potential allergens that may initiate asthma pathogenesis. In contrast, on non-Hutterite farms with less access to daycare, young children may be brought into the work environment by their parents (14), thus increasing the likelihood of exposure to respirable agents located in that environment.

Ball et al (27) found that there was a decrease in the risk of asthma in children who were exposed to daycare settings within the first six months of life compared with children who were kept in home environments (RR 0.6, 95% CI 0.4 to 0.8). These findings have been further supported by Infante-Rivard et al (28) in a prospective Canadian cohort study of urban children. Ball et al (27) suggest that the daycare setting may increase exposure to commonly spread infections that could further protect against asthma. Hutterite colonies are relatively closed communities, and the previous works by Ross et al (6,7) suggests that Hutterite populations appear less likely to contract a wide variety of common bacterial and viral infections than do age-, sex- and region-matched control subjects. Both nurseries and schools are located within the colonies, and there is minimal exchange between children from the colonies and those living in outside farming communities (1). However, this relative isolation would not preclude the spread of infections if they occurred within the colony setting. We did not study the daycare patterns of non-Hutterite farming environments to determine how those patterns compared with observed patterns in colonies. However, as previously mentioned, daycare for non-Hutterite families in rural areas can be very limited.

The prevalence of asthma and other respiratory symptoms in the previously studied Hutterite populations of South Dakota do not generally support our findings (3,13). In the Schmiedeleut Hutterite population studied by Ober (3), the prevalence of asthma was 15.1%. The genetic link for asthma appears to be well established in this Hutterite sample, although, as in the general population, a specific locus is uncommon. Parry and Schlenker (13) conducted a study of 206 Schmiedeleut Hutterite high school children and 87 non-Hutterite high school controls in South Dakota. All participants were of similar European descent. Although asthma was not reported in this study, Hutterite adolescent males had significantly less wheeze, excluding colds, bronchitis and pneumonia. Compared with same sex control subjects, Hutterite children had lower lung function volumes for forced expiratory volume in 1 s. The Schmiedeleut Hutterite sects studied in South Dakota by Ober (3), and Parry and Schlenker (13) are not found in Saskatchewan and, therefore, are not represented in the present study. Limited information about environmental practices and differences in the ages of Hutterite populations in the studies by Ober (3), and Parry and Schlenker (13) make comparisons with the present study difficult. The small number of participants from Hutterite colonies in the present study limited the analysis of Hutterite groups by sect. However, the two cases of asthma reported in the Hutterite population were from two Saskatchewan leutes – Darius Leut and Lehrerleut.

Our assumption was that there would be no significant difference in the prevalence of asthma between these two farming populations. While genetic factors could be a major influence for the low prevalence of asthma within this Hutterite population, the absence or reported lower frequency of exposures to potential asthmogenic factors found within the Hutterite child's environment may also have influenced the expression of asthma in this group. Further examination of the prevalence of asthma in other Hutterite populations of children would be important in determining if the prevalence of asthma and wheeze found in the present study is consistent with that of the other Hutterite sects. As well, the interaction between genetic and environmental factors should be investigated further.

ACKNOWLEDGEMENTS: This research was supported by the National Health and Research Development Program of Health Canada through a National Health Research Doctoral Fellowship to D Rennie.

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