

Research

Respiratory tract infections in Inuit children: "Set thine house in order"

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∞ See related article page 155

Lower respiratory tract infection is a major cause of illness and death among the Inuit children of Nunavut. In peak years the attack rate of bronchiolitis among Inuit infants has reached 57% in some communities.¹ In the Qikiqtaaluk (Baffin) region of Nunavut, the annual hospital admission rate for infants with bronchiolitis and viral pneumonia was 197 per 1000 infants between 1999 and 2002.² Similar findings have been documented in studies of Inuit children in other regions of Canada, Greenland and Alaska.³⁻⁵

The search for risk factors for lower respiratory tract infection in Inuit children has taken researchers to the 3 corners of the epidemiologic triangle: environment, host and agent. In this issue of *CMAJ*, Kovesi and colleagues⁶ explore the relation between environmental indoor air quality and lower respiratory tract infection in Inuit children. Their study showed a mean of 6.1 occupants per house, compared with 3.3-4.4 in southern Canada. Of the houses studied, 80% had ventilation rates below recommended Canadian standards. The mean indoor carbon dioxide (CO₂) concentration was higher than the Canadian recommended level. They observed a significant association between reported lower respiratory tract infection in the youngest child of the household and both mean household CO₂ levels and occupancy. The prevalence of smokers in the study sample (93.9% of households) and a failure to differentiate the location of smoking (inside or outside the house) precluded any meaningful analysis of this variable as a risk factor for lower respiratory tract infection in the household child.

The authors acknowledge that small sample size, and potential sampling bias, limit the generalizability (external validity) of this study. Four of approximately 13 communities of the Qikiqtaaluk region were chosen for study. Although the authors do not explain their choice, we may hypothesize that it was related to community access and the wishes of Nunavut Housing Corporation and local Inuit associations. Forty-nine houses were studied: 3 from Cape Dorset, 7 from Igloodik, 15 from Clyde River and 24 from Pond Inlet. The 2006 Canadian Census reports the number of private dwelling occupied by the usual residents in these communities as 321, 329, 173 and 311, respectively. It is clear that the sample size is very small. In addition, the authors note that

the identification of the houses to be studied by the Nunavut Housing Corporation and the local housing councils results in potential selection bias.

Nevertheless, their findings come as no surprise to those who live, work and study in the Canadian north. Both the quantity and quality of living space in Nunavut are inadequate.^{4,7,8} According to the 2001 Aboriginal Peoples Survey, in which overcrowding is defined as one or more persons per room in a dwelling, 54% of Inuit in Nunavut live in overcrowded conditions.⁹ In the face of a birth rate that is more than twice the Canadian average, the gap between existing living space and future need is increasing rapidly.⁹ The dwellings of Inuit families are also more likely to be in need of major repair.⁷ Climatic factors and poor construction contribute to inadequate ventilation. Excessive humidity was not found in the houses studied by Dr. Kovesi. However, dampness and mould from condensation caused by inadequate ventilation, improper landscape drainage, or leakage from roofs or water pipes are a recurring problem in many houses in First Nations communities.¹⁰ Studies have suggested an association between indoor fungal exposure and increased susceptibility to respiratory infection, altered T-cell differentiation in children, and the development of asthma and allergies.¹¹

Kovesi and colleagues discuss limitations to the internal validity of their study, including questions about interrater reliability, diagnostic misclassification and recall bias. These methodologic concerns relate to the use of multiple surveyors and reliance on responses from householders (unidentified in the paper) to distinguish episodes of bronchiolitis from those of pneumonia and other respiratory illness. It is more likely that the responses broadly reflect episodes of both upper and lower respiratory tract infection.

It is unclear whether crowded housing and inadequate ventilation are risk markers (reflecting association) or risk factors (reflecting causation) for respiratory tract infection in children. Low socioeconomic status is associated with poor housing, and multiple logistic regression in one study

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Key points

- Inuit children experience high rates of illness and death from lower respiratory tract infection
- Overcrowding (due to an undersupply of housing) and inadequate ventilation (because of high occupant density, construction problems and harsh climate) of houses have been identified as associated factors
- Healthy housing in northern communities is required to improve the health and well-being of Inuit children

showed that socioeconomic status is a stronger predictive factor for the frequency of visits to health centres.^{4,12} Poor housing quality and overcrowding may be associated with, and a proxy for, more specific factors for exposure, susceptibility or resistance to infection; for example, adequacy and type of nutrition (including breastfeeding), behaviour resulting in exposure to infectious agents (e.g., within child care settings) and exposure to environmental contaminants (including tobacco smoke).

The study by Kovesi and colleagues prompts several questions. How are Canadian limits for recommended housing ventilation and CO₂ levels determined? Should these limits be uniform across the country, or be adjusted to take local rates of illness and death into account, as well as the considerable challenges and costs associated with construction in northern communities? Should a large number of houses of current design be built in Nunavut, or a smaller number of larger houses of more culturally appropriate design? The houses in Nunavut follow Euro-Canadian designs for single nuclear families, with segregated spaces for specific functions rather than open multifunctional spaces for extended communal, family life.⁸ If health is interpreted to include a sense of well-being supported by connections to culture and tradition, healthy housing must be designed not only to provide adequate ventilation but also to accommodate the collective social behaviour of Inuit families.

Investigation of the other 2 corners of the epidemiologic triangle, agent and host, is required to gain a better understanding of the causes of respiratory tract infection in Inuit children. The incidence of disease and virulence associated with select infectious agents is greater in Inuit and certain First Nations populations; examples include *Streptococcus pneumoniae* serotype 1, *Mycobacterium tuberculosis* (specific Manitoba isolates), *Hemophilus influenzae* and respiratory syncytial virus.^{13,14} It is not clear what role *Chlamydia pneumoniae*, *Mycoplasma pneumoniae* and human metapneumovirus play, if any. Well-designed prospective community studies to determine the full spectrum of infectious causes of respiratory tract infection in Inuit children are lacking. With regard to the host, we have an incomplete understanding of genetic markers for susceptibility or resistance to infectious and inflammatory disease among the Inuit. Defi-

ciencies in humoral and cell-mediated host genetic response to infections and to selected vaccines have been identified among the Inuit.^{4,15}

Apparently heeding the admonishment of the Old Testament prophet Isaiah to “Set thine house in order” (Isaiah 38:1), the government of Nunavut developed the *Nunavut Ten-Year Inuit Housing Action Plan*,⁹ which calls on the federal government to honour its obligations to the Inuit of Nunavut. The word “thine” should be understood to encompass joint “ownership” of the task on the part of funders, designers, builders and occupants. The word “order” defines an environment that supports and promotes health in its broadest sense.

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