Health Disparities in Chickenpox or Shingles in Alberta?

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ABSTRACT

Objective: Exploring for evidence of socio-economic health disparities in chickenpox and shingles in Alberta, Canada.

Methods: Chickenpox and shingles cases were identified from administrative data from Alberta's universal health care insurance system for 1994-2002. Incident cases were those with the earliest dated utilization of a health service (chickenpox: ICD9-CM 052/ ICD10-CA B01; shingles: ICD9-CM 053/ ICD10-CA B02). Crude and age-specific rates were estimated for each year by an indicator of socio-demographic status based upon the nature of the payer and eligibility for health care premium subsidy (SES-proxy) for the provincial health care insurance system.

Results: Among young children there is a gradient of disparity in chickenpox rates prior to the year in which publicly funded vaccination programs were implemented. After this point, disparities decline but less so for First Nations children than for others. There was no evidence of disparity by SES-proxy for shingles.

Conclusion: Publicly funded vaccination programs may effectively contribute to reduction in disease disparities for vaccine-preventable diseases. Further study is required to ascertain why disparities continue for First Nations children.

Key words: Herpes zoster; chickenpox; Canada; population surveillance; social class; income; Indians, North American

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Canadians of lower socio-economic status (SES) and Aboriginal identity are known to incur health disparities.^{1,2} These include elevated rates of some vaccine-preventable diseases (e.g., pertussis, rubella) among Aboriginal peoples.³

Varicella vaccine was licensed in Canada in 1998, and Alberta initiated a publicly funded vaccination program in April, 2001. Starting in 2001, Health Canada – First Nations & Inuit Health Branch – Alberta Region implemented a funded varicella vaccination program within their routine immunization program which paralleled the provincial program (personal communication, Ruth Richardson, Regional CDC Nurse Manager Health Canada FNIHB, Alberta Region, August 8, 2006). We explore for evidence of disparities in the occurrence of varicella (chickenpox) and varicella zoster (shingles) in Alberta, using administrative data from Alberta's universal, publicly funded health care insurance system for the period 1994-2002. There are few data addressing disparities (especially for Aboriginal peoples) related to these diseases.

METHODS

Over 99% of Alberta's 3 million residents are covered by the provincial health care insurance plan. Information on each insured person is maintained in a provincial registration file which includes demographic information as well as a unique lifetime personal health number (PHN) which can be used to link the registration file to a variety of health data sources. Alberta collects a health care insurance premium on a quarterly basis; therefore the accuracy of the registry is maintained during inter-censal periods.⁴ Health Canada is responsible for the payment of these premiums for First Nations treaty-status Aboriginals. Therefore, this status is tracked by Alberta Health and Wellness and an indicator of treaty status can be created.⁵ The premiums for all individuals on social services are paid by the government, which permits social service status to be tracked and an indicator formed by Alberta Health and Wellness. For all other Albertans, the registry includes whether or not the person is eligible for health care premium subsidy based upon taxable family income from the previous calendar year. All of this information was used to create a

single socio-economic status indicator variable (SES-proxy) with 4 mutually exclusive categories (Table I) that are useful for persons aged less than 65 years (the government of Alberta waives the premium for persons aged 65 or older). We used the PHN for deterministic linkage between the registry, the electronic fee-for-service data system and the Hospital Morbidity Inpatient Database to identify incident cases of chickenpox and shingles.⁶ Chickenpox cases were identified using ICD9-CM 052 or ICD10-CA code B01; shingles cases by ICD9-CM 053 or ICD10-CA code B02; as recorded in any of the three fields available in a physician record or in any of the 16 diagnostic fields available in a hospital record. Incident cases were defined by the earliest date in any of the databases that permitted the identification of a unique individual for which the relevant diagnostic code in any diagnostic field was identified. Data for persons with more than one chickenpox or shingles code were included as incident only for the earliest date at which the code was identified. Crude and age-specific rates of chickenpox and shingles were estimated for 1994-2002. Denominators for rates were estimated using mid-year population estimates from the Alberta Health Care Insurance Registry.

Data analysis

We used a sequence of logistic regression analyses to explore for SES-proxy, age, and year effects for both chickenpox and shingles. First, age group, SES-proxy and year were each considered as categorical variables and a model was solved with main effects for age group, SES-proxy, and year. Then two-way interactions between these factors were added to the model. SPSS 14.0⁷ was used for data analysis.

This study was approved by the Conjoint Health Research Ethics Board of the University of Calgary.

RESULTS

Figure 1 shows chickenpox rates for each SES-proxy group by age. For children aged less than five years of age, there is a clear gradient by SES-proxy in rates of chickenpox. Odds ratios (OR) from the logistic regressions were used to compare the SES-

TABLE I
SES-proxy Categories

Category	Definition
First Nations	Health Canada is responsible for the payment of provincial health care premiums for First Nations treaty-status Aboriginals. The individual is a treaty-status Aboriginal according to Health Canada, regardless of residence on or off reserve.
Social Services	Alberta Human Resources and Employment pays the health care premiums on behalf of these persons. This group includes people who receive financial support under various provincial Social assistance programs, including Supports for Independence (welfare), Assured Income for the Severely Handicapped, and child welfare.
Subsidy	Individuals who qualify for a subsidy or waiver of their health insurance premium on the basis of low income. Persons who suffer financial hardship (including job loss), or who are new to Canada who have successfully applied for a waiver of health insurance premium (20% - 100% reduction in premium, based on income as verified by prior year income tax).
No Subsidy	The individual is required to pay the full Alberta Health Care Insurance Plan premium (direct pay or through employer groups).

Figure 1. Chickenpox by SES-proxy and age group to age 65, Alberta, 1994-2002

proxy groups, with the no-subsidy group as the reference category. The highest rate is experienced by the First Nations group (OR 2.5 vs. no-subsidy group, 95% CI: 2.32-2.71) followed by the Social services group (OR 1.3, 95% CI: 1.13-1.42) and the subsidy group (OR 1.2, 95% CI: 1.07-1.25). Disease rates decline steeply among older age groups and the difference by SES-proxy groups steeply narrows starting with age group 1-4 years and subsequently disappears (age group by SES-proxy interaction, Wald statistic = 567.8, df=15, $p < 0.01$). Figure 2 displays annual rates of chickenpox by SES-proxy for children aged less than one year. The higher rate for the

First Nations group is present in every year. Differences in disease rates for the other groups show no consistent gradient by SES-proxy after 1995. Chickenpox rates decline in 2002 (OR 0.63, 95% CI: 0.56-0.72) but markedly less in the First Nations group (OR 1.2 SES-proxy by Year interaction, 95% CI: 1.01-1.37). Figure 3 displays annual rates of chickenpox by SES-proxy for children aged 1 to 4 years. Again, the higher rate for the First Nations group is generally present. Chickenpox rates markedly decline in 2002 for all groups (OR 0.48, 95% CI: 0.45-0.50), though First Nation rates remain highest. Among older children (data not shown), all groups

Figure 2. Chickenpox by SES-proxy and year, age <1 year, 1994-2002

Figure 3. Chickenpox by SES-proxy and year, age 1-4 years, 1994-2002

(including First Nations) show similar steep declines in chickenpox rates after 2001.

As can be seen in Figure 4, shingles increases for all SES-proxy groups by age

(age group main effect, Wald statistic = 10268.2, $df=13$, $p<0.01$). There is no consistent pattern of elevated rates for any SES-proxy group across all age groups; nor any consistent pattern among the non-First Nations groups that would be consistent with a clear income gradient for all age groups.

INTERPRETATION

Our data build upon prior work that has shown that the incidence of chickenpox in Alberta varies by age group and year, and that there is evidence of age group/year interactions.⁶ To our knowledge, this is the first published report that explores for SES-related health disparity for chickenpox and shingles incidence in Canada, including for First Nations peoples. For chickenpox, our data show evidence of health disparity among children by SES-proxy, especially for First Nations children. Particularly prior to the implementation of chickenpox vaccination programs, the mechanisms that could lead to this might include increased exposure to disease among susceptibles due to one or more of the following: crowded housing, larger family size, or a decrease in host resistance; related poor nutrition may also be a factor. These factors might be most severely experienced by people living in poverty. Although our SES-proxy did not directly measure income for the First Nations group, many registered Indians live in poverty whether or not they live on reserve.^{8,9} Chickenpox vaccine is given to children aged 12 months or older and publicly funded vaccination programs were implemented for all children in Alberta starting in 2001. Although the decline in rates for all SES-proxy groups seen after 2001 (consistent with vaccination-program effect) is also seen for First Nations children, the rate of decline is less steep than for other children aged 1 year or older. Among children less than one year of age, a decline after 2001 is also seen for non-First Nations children. This decline is consistent with herd effect,¹⁰ but is not seen for First Nations infants. Publicly funded immunization programs might be conceptualized to be strategies to reduce health disparities. Our data suggest that this strategy has been partially successful, but less so for First Nations children. After the imple-

mentation of publicly funded vaccination programs in 2001, the observed disparities in chickenpox among children over the age of 12 months might be consistent with one or more of lower vaccination coverage or lower vaccine efficacy among First Nations children. Either possibility would be consistent with the lack of evidence for herd effect among First Nations children under one year of age. We have proposed elsewhere⁶ that an immunization registry that could be linked to other provincial health data sources would be useful. Were such a registry in existence (currently not the case), it might permit the testing of hypotheses related to variance in vaccination coverage rates by SES-proxy.

With respect to shingles, we saw no clear and consistent trend related to SES-proxy, consistent with the literature.¹¹ However, data are few and methodological issues complex. These include a requirement to consider illness versus preventive care, having a chronic health condition, type or provider used and type of care setting (e.g., hospital). Additionally, one must distinguish between “contact” (i.e., using a health care service) and “intensity” (i.e., volume of use).¹² We did not specifically study the relationship between SES and health service utilization *per se*. Rather, we used health service utilization records to identify incident cases of both shingles and chickenpox, then explored for relationships between SES-proxy and these incidence rates. Our research question did not address the “intensity” of health service utilization. We found evidence of disparity in the incidence of chickenpox: higher rates for people of lower SES, and higher rates for FN people. We do not think that the observed higher rates can be explained by confounding due to higher rates of health service utilization for all health conditions by these population groups. In Alberta, most physician visits use primary care physicians, and it is “intensity”, not “use” of primary care services that is related to SES.^{12,13} Higher-income people are more likely to see a specialist. Thus if the only operative factor in our analysis were SES as a determinant of health service utilization, we would expect to see the opposite trend to that which we observed. Several Canadian studies have looked for relationships between race or ethnicity and health service utilization, but have used a

Figure 4. Shingles by SES-proxy and age group to age 65, Alberta, 1994-2002

measure of “visible minority” that excluded Aboriginal peoples.¹²⁻¹⁴ Quan and colleagues¹⁴ observed that after adjustment for other socio-demographic and health characteristics, visible minorities (Aboriginals were not included) were more likely than whites to have contact with a general practitioner but not with a specialist. If Aboriginal people followed this pattern of health service utilization, it might explain our finding that FN children had a higher rate of chickenpox than others. We think this unlikely. In Manitoba, Aboriginals (whether living on or off reserve) have lower rates of childhood immunization, screening mammography and breastfeeding initiation than other Manitobans.¹⁵ Further, Health Canada has shown that FN peoples, generally, within Canada have disproportionately higher rates of notifiable vaccine-preventable diseases than other Canadian children.³

We did not validate diagnostic codes. Others have shown that the positive predictive value of a shingles diagnosis in administrative data is lower for children aged 0-2 years (71%) than for older children (82%) or adults.^{16,17} Nonetheless, age-specific variations in shingles rates persisted after adjustment for predictive values.¹⁶

The most likely impact of such a bias would be an over-estimation of shingles rates among the youngest age groups; however there is no reason to expect that there would be an impact on the relationship between SES-proxy and rates of disease, and our findings are consistent with Health Canada findings that FN people have higher rates of other notifiable diseases.³

Shingles occurs as a result of a reactivation of latent infection with varicella virus. Mechanisms that have been posited to be related to this include loss of VZV-specific immunity (from lack of episodic exposure to virus – often measured by the presence and number of children in a household), generalized loss of cell-mediated immunity (e.g., from immunosuppressive therapies or disorders), and other factors such as trauma in the affected dermatome or genetic susceptibility.¹¹ It has been hypothesized that increased psychological stress, or a lack of stress buffering from social support may depress cell-mediated immunity leading to an increase in shingles.¹¹ Similarly, exposures to some environmental contaminants might also suppress cell-mediated immunity. As these exposures might also be related to poverty,¹⁸ there are plausible

biological pathways that lead to an expectation for income-related disparities in the occurrence of shingles. Our failure to observe such a gradient might be due to one or more of the following: a true finding; an insufficiently wide gradient across categories; or variability in the amount of time spent in a lower socio-economic status group.¹⁸

CONCLUSION

Prior to the date of implementation of publicly funded chickenpox vaccination programs in Alberta, there was evidence of disparity in chickenpox rates by SES-proxy. The burden was greatest for First Nations, followed by Social Services, followed by people eligible for health-care premium subsidy. Publicly funded chickenpox vaccination programs have likely been the cause of a reduction in this disparity; but have been less successful in reduction for First Nations than for other children.

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RÉSUMÉ

Objectif : Prouver l'existence de disparités socioéconomiques sur le plan de la santé en matière de varicelle et de zona en Alberta (Canada).

Méthode : Les cas de varicelle et de zona ont été repérés à partir des données administratives du système universel d'assurance-maladie de l'Alberta pour la période de 1994 à 2002. L'incidence des cas a été déterminée en fonction de la date la plus ancienne d'utilisation des services de santé (varicelle : CIM9-MC 052/ CIM10-CA B01; zona : CIM9-MC 053/ CIM10-CA B02). Les taux bruts et par âge ont été estimés pour chaque année selon un substitut du statut socioéconomique (SSE) : un indicateur du statut sociodémographique fondé sur la nature du payeur et l'admissibilité au programme de subvention des primes versées en vertu du système provincial d'assurance-maladie.

Résultats : Chez les jeunes enfants, on observe un gradient de disparité dans les taux de varicelle avant l'année d'instauration des programmes de vaccination subventionnés par l'État. Après cette date, les disparités diminuent, mais dans une moindre mesure pour les enfants des Premières nations que pour les autres enfants. Aucune disparité selon le substitut du SSE n'est observée pour le zona.

Conclusion : Les programmes de vaccination subventionnés par l'État peuvent effectivement contribuer à réduire les disparités à l'égard des maladies évitables par la vaccination. D'autres études sont nécessaires pour vérifier pourquoi des disparités persistent chez les enfants des Premières nations.

Mots clés : zona; varicelle; Canada; surveillance dans la population; classe sociale; revenu; Amérindiens