

POPULATION HEALTH ANALYSIS OF CHILDHOOD INJURIES IN HEALTH AREAS IN BC, CANADA

Raina, P.^{1,2}, Soubhi, H.^{1,2}, Rajabali, F.¹, Turcotte, K.¹, & Tufts, C.¹, Chambers, L., Abernathy, T.

¹ BC Injury Research and Prevention Unit
² Department of Health Care and Epidemiology, University of British Columbia

Introduction

Relevant policies and interventions directed to injury prevention at the population level must be formed on the basis of a comprehensive understanding of the broad determinants of injuries. Although we have basic knowledge regarding these determinants their relative contribution to the variation in injury across communities needs to be fully delineated, both individually and in combination.

Objective 1

To describe Local Health Areas (LHAs) on the basis of aggregated community indicators. This will entail the description of the range of variation for each of the indicators used as well as the range of variation of injury rates across regions.

Methods

Sources of Data

Injury Hospitalization: B.C. Ministry of Health (1986-1997)

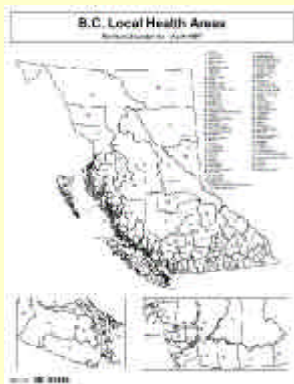
Population Indicators: Census of Canada Municipal Statistics Police Services

- BC injury hospitalization rates were calculated through indirect standardization to the BC average rates 1986-1997.
- 1991 indicators were normalized by subtracting the provincial average from the observed score for each LHA and dividing the result by the indicator's standard deviation
- LHAs (83) were ranked on the basis of these z-standardized indicators

Results

Making comparisons between "high" and "low" injury LHAs:

- Injury hospitalization rates were higher with higher proportions of single-parent families.
- Injury hospitalization rates were lower with higher proportions of immigrant population.
- Injury hospitalization rates were lower with higher external physical environment scores.
- Injury hospitalization rates were higher with higher neighborhood disadvantage scores.
- Injury hospitalization rates were higher with higher availability and use of health care.



Objective 2

To examine the extent to which population health indicators such as those describing demographic, social and economic conditions, the physical environment, health care capacity, legislation and public health policies can either directly or indirectly account for the variation in rates of injuries across Local Health Areas (LHAs).

Hypotheses

Direct

- Better economic environment is related to lower injury rates
- Better physical environment is related to lower injury rates
- Higher life expectancy is related to lower injury rates
- High adult/juvenile crime is related to higher injury rates
- Better social environment is related to lower injury rates

Indirect

- Better economic environment is related to higher life expectancy which in turn is related to lower injury rates
- Better economic environment is related to better physical environment which in turn is related to lower injury rates
- Better economic environment is related to lower adult and juvenile crime which in turn is related to lower injury rates
- Better economic environment is related to better social environment which in turn is related to lower injury rates

Interaction Terms

- Economic Environment by Health and Function
- Economic Environment by Physical Environment
- Economic Environment by Social Environment
- Economic Environment by Adult and Juvenile Crime

Methods

- Factor Analysis using varimax rotation was performed on all 1991 normalized indicators
- Indicators were grouped into domains based on previous research
- Within each domain:
 - Indicators that did not load onto a factor were discarded or retained as a separate covariate
 - Indicators that loaded onto a single factor had their normalized values summed to create a score
- Relationships between injury hospitalization rates and indicator scores were modeled using Poisson regression:
 - Univariate Analysis
 - Multivariate analysis by each domain
 - Multivariate analysis with domain interactions
- Third variable approach was used to assess indirect effects

Example of the indirect influence of SES on injury using physical environment as a third variable.

$$\text{Equation 1: Physical Environment} = b_{00} + b_{(SES)} + b_{\text{covariates}} + \text{error}$$

$$\text{Equation 2: Log (Injury Rate)} = b_{01} + b_{(SES)} + b_{\text{covariates}}$$

$$\text{Equation 3: Log (Injury Rate)} = b_{02} + b_{(\text{physical environment})} + b_{(SES)} + b_{\text{covariates}}$$

To establish indirect intervening effect, the following conditions must hold:

- the independent variable must be significantly related to the third variable in the first equation
- the independent variable must be significantly related to the dependent variable in the second equation
- the third variable must be significantly related to the dependent variable in the third equation.
- the introduction of the third variable must reduce the direct relationship (found in the second equation) between the independent and the dependent variable. Perfect intervening effect holds if the independent variable has no effect on the dependent variable when the third variable is controlled.

Results

Factor Analysis

DOMAIN	Factor for Analysis	Component Indicators
SOCIAL ENVIRONMENT	Marital Status	Married
	Language	Knowledge of English
	Immigration	% immigrant population
	Size of Economic Family	<= 4 per family 4 per family
PHYSICAL ENVIRONMENT	Single-parent Families	male headed single-parent family female headed single-parent family

DOMAIN	Factor for Analysis	Component Indicators
PHYSICAL ENVIRONMENT	External Environment	improved lanes and alleys local streets and roads major urban thoroughfares public parks and playgrounds total roads and streets surfaced roads sewer and water systems

DOMAIN	Factor for Analysis	Component Indicators
ECONOMIC ENVIRONMENT	Neighborhood Disadvantage	education employment average household income government transfer payments

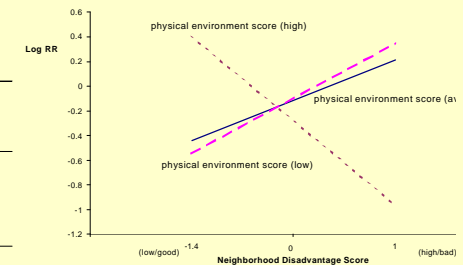
DOMAIN	Factor for Analysis	Component Indicators
CRIME	Adult Crimes	violent non-violent & traffic
	Juvenile Crimes	violent non-violent

DOMAIN	Factor for Analysis	Component Indicators
HEALTH & FUNCTION	Life Expectancy	life expectancy

Poisson Regression

- A high neighborhood disadvantage (i.e. poor economic environment) score is associated with high injury rates.
- There is a significant interaction between neighborhood disadvantage and external physical environment.
- The effect of neighborhood disadvantage is not mediated by:
 - Life expectancy
 - Social Environment
 - Physical Environment

Log Injury Rate for High, Medium and Low Values of Neighborhood Disadvantage and Physical Environment Scores



The following numerical values were used for illustration: Physical Environment: low = -.28, average = 0, high = 2.33. Neighborhood Disadvantage: low = -1.4, high = 1.

Relative Risks Estimates from Poisson Regression of Injury Rates on Selected Domains Indicators

Variables	Main Effects Model			Interaction Effects Model		
	RR	SE	95% CI	RR	SE	95% CI
Married	1.01	.04	.94 1.08	1.02	.03	.95 1.09
Knowledge of English	1.05	.05	.97 1.15	1.07	.05	.98 1.17
Size of Economic Family	.88	.10	.70 1.09	.91	.10	.73 1.13
Single-parent families	.92	.03	.86 .99	.94	.03	.87 1.01
Immigration	.93	.07	.81 1.07	.86	.06	.75 1.00
Neighborhood Disadvantage	1.33	.13	1.11 1.62	1.29	.13	1.06 1.57
Life Expectancy	.87	.07	.75 1.00	.89	.06	.78 1.01
Ext. Physical Environment	.90	.03	.84 .95	.83	.04	.77 .91
Adult Crime	1.55	.12	1.33 1.81	1.50	.12	.99 1.75
Juvenile Crime	.85	.07	.71 1.00	.86	.07	.73 1.00
Neighborhood Disadvantage by External Physical Environment				.70	.11	.51 .94

Conclusion

This study indicates the need for increased research on the relationships between the indicators composing neighborhood disadvantage and those composing external physical environment.

The final set of indicators developed from this research will provide a baseline for monitoring injuries and informing injury control policies.

Future Research

- Separate Regression analysis for:
 - Age group and sex
 - Leading types of injury
 - Leading causes of injury
- Similar analysis for mortality data