

Health Disparity by Neighbourhood Income

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ABSTRACT

Background: Canadian cities are becoming more segregated by income. As such, investigation is required into the magnitude of health disparity between low-, average- and high-income neighbourhoods in order to quantify the level of health disparity at the scale of an urban city.

Methods: A cross-sectional ecological study design was used to review all hospital discharges, physician visits, medication utilization, public health information and vital statistics for an entire city by neighbourhood income status. Postal code information was used to identify six existing contiguous residential neighbourhoods in the city of Saskatoon that were defined as low-income cut-off neighbourhoods (N=18,228). There were two comparison groups: all other Saskatoon residents (N=184,284) and the five most affluent neighbourhoods in Saskatoon (N=16,683).

Findings: Statistically significant differences in health care utilization by neighbourhood income status were observed for suicide attempts, mental disorders, injuries and poisonings, diabetes, chronic obstructive pulmonary disease, coronary heart disease, chlamydia, gonorrhoea, hepatitis C, teen birth, low birthweight, infant mortality and all-cause mortality. The rate ratios increased in size when comparing low-income neighbourhoods to high-income neighbourhoods. No clear trend was observed for stroke or cancer.

Interpretation: The findings suggest that low-income neighbourhoods are associated with increased health care utilization in Saskatoon.

MeSH terms: Health; socioeconomic factors; income; residence characteristics

Many studies from different countries and diverse settings have found a strong correlation between life expectancy and socioeconomic status (SES).¹⁻⁵ Historically, most of the studies reviewing SES and health status are at the individual rather than the neighbourhood level.^{3,6-13} Recent studies suggest that neighbourhood SES can independently influence individual health above and beyond individual SES.⁹⁻¹³ As such, research on the independent effect of individual and neighbourhood SES on health status is fairly well documented. Although the previous research is very important, there are several considerations: 1) most peer-reviewed research is American or British, 2) most papers use national-level census data with analysis at the national or provincial level, 3) when national-level census data is broken down into regional data, the census tract boundaries can create proxies for neighbourhoods that might not be meaningful, 4) analysis at the regional level normally results in very small sample size, and 5) health information is normally self-reported.^{6,9-16}

Almost all Canadian cities are becoming more segregated by income.¹⁴ As such, investigation is required into the magnitude of health disparity between low-, average- and high-income neighbourhoods in order to quantify the level of health disparity at the scale of an urban city.¹⁴ The objective of the current research is to use a cross-sectional ecological study design to determine the association between neighbourhood income and health care utilization in the city of Saskatoon, Canada (N=202,512).

METHODS

The last census in Canada was performed in 2001.¹⁷ Postal code information from the census was used to identify six existing residential neighbourhoods in the city of Saskatoon that were defined as “low income cut-off neighbourhoods” by Statistics Canada.¹⁸ All six neighbourhoods were touching or contiguous pre-existing municipal boundaries (Figure 1). A neighbourhood is designated low income (or high poverty) when more than 30% of the families in the neighbourhood meet the definition of low income cut-off. A family is designated low income when they spend more than 70% of family income on basic

La traduction du résumé se trouve à la fin de l'article.

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necessities like food, shelter and clothing. Cut-off points are adjusted for family size, population of city or area of residence, urban/rural differences and consumer price index. Additional socio-economic information from the census was collected including neighbourhood education status and employment status (Table I).

Health care utilization information in Saskatchewan includes location of residence by postal code. As such, specific health information was collected on residents who lived in the low-income neighbourhoods (N=18,228). Two comparison groups were established. The first comparison group was all other Saskatoon residents (N=184,284). The second comparison group was the five most affluent neighbourhoods in Saskatoon identified by Statistics Canada census information on income status. The five neighbourhoods in the affluent group were also contiguous municipal boundaries and had similar population size (N=16,683) to that of the low-income neighbourhoods (Figure 1).

Saskatchewan has universal health coverage for all residents with a centralized administrative database that collects information on all hospital discharges or separations, physician visits, medication usage, public health information and vital statistics. Information was collected on the eight most common diseases and disorders in Saskatoon (suicide attempt, mental disorder, injuries and poisonings, diabetes, chronic obstructive pulmonary disorder, coronary heart disease, stroke and cancer) resulting in hospital discharge by most responsible diagnosis (ICD9 codes¹⁹) for the year 2001 (to coincide with the latest census year). The positive predictive value of a primary diagnosis from hospital data in Saskatchewan is 90%.²⁰ Information on the same diseases (excluding suicide attempts) was collected for overall physician visits in 2001.

Medication information was collected for all prescriptions filled in 2001 for the entire population for mental disorders (anti-depressants and antipsychotic agents) and diabetes (insulin pork/human biosynthetic and oral hypoglycemics). Medication data required an extra data request from Health Canada as the federal government in Canada is responsible for payment of medication expenses for Registered Indians (a historical legal term for treaty purposes).

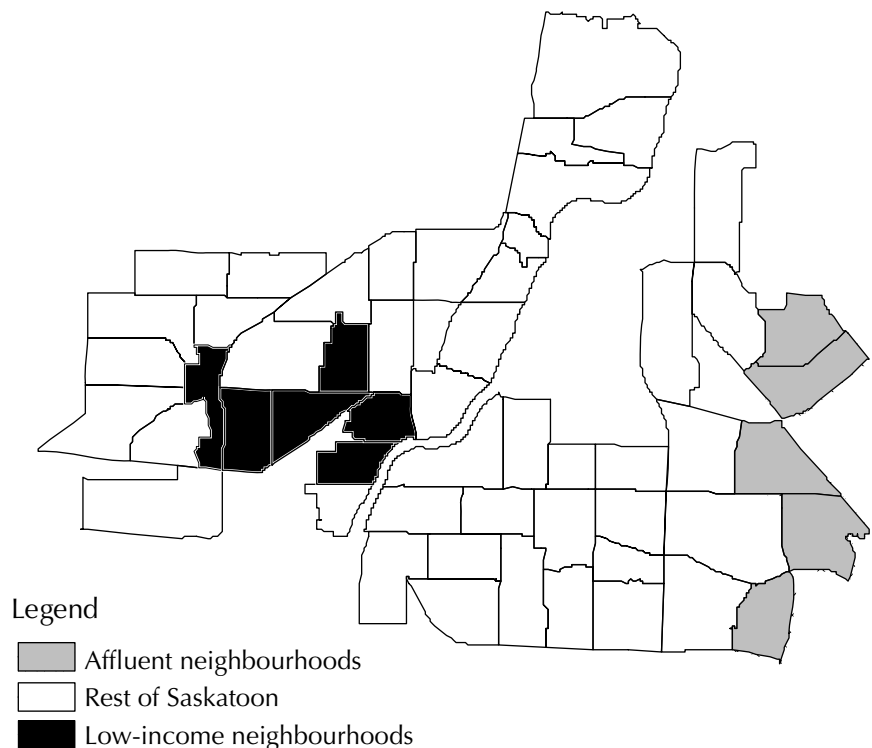


Figure 1. Statistics Canada low-income cut-off designation for six Saskatoon residential neighbourhoods in 2001

Source: Saskatoon Health Region, Public Health Service

TABLE I

Comparison of Socio-economic Status in Saskatoon Neighbourhoods

	Low-income Neighbourhoods	Rest of Saskatoon	Affluent Neighbourhoods
Population size*	18,228	184,284	16,683
Average family income	\$30,429	\$63,705	\$99,096
Incidence low income, % (CI)†	44.0 (42.5-45.6)	12.3 (12.0-12.6)	3.7 (3.2-4.3)
Less than grade 9 education, % (CI)	14.8 (14.2-15.5)	5.3 (5.1-5.4)	2.2 (2.0-2.5)
Unemployment, % (CI)	18.1 (17.2-19.1)	6.5 (6.3-6.6)	4.3 (3.9-4.7)

Information Source: 2001 Statistics Canada Census

* Population size is based on the Saskatchewan Health covered population

† (CI) refers to 95% confidence interval

Missing data is unlikely because documentation for hospital visits, physician visits and medication payments are required for administrative, legal and financial reasons. Misclassification at point of data entry is unlikely due to double data entry and verification procedures.

Public health information was collected on the three most common infectious diseases in 2001 (chlamydia, gonorrhoea and hepatitis C). The rates for these diseases were based on positive provincial lab test counts for new cases in 2001 and not for investigations or treatment. Vital statistics information included teen births (15-19 years old) and low birthweights (less than 2500 grams). All-cause mortality and infant mortality for the year 2001 were

also included. Public Health and vital statistics information were generated by Saskatchewan Health and verified by Population Health Surveillance at the Saskatoon Health Region.

Age-standardized rates were computed for the diseases and disorders mentioned above for the low-income neighbourhoods, the rest of Saskatoon and the affluent neighbourhoods. Age standardization used a direct method with the 2001 Canadian population as the standard. The denominator was per 100,000 population in 2001 for all variables except teen birth and infant mortality (per 1000 live births). Population size was based on the population covered by Saskatchewan Health insurance. Ninety-five percent confidence

TABLE II
Health Disparity by Neighbourhood Income

Disease Category and ICD9 Code Range	2001 Age-standardized Rate (95% confidence intervals)				Affluent Neighbourhoods N=16,683	Ratios (95% CI) Low:Rest	Ratios (95% CI) Low:Affluent
	Low-income Neighbourhoods N=18,228	Rest of Saskatoon N=184,284					
Number of Hospital Separations*:							
Suicide Attempt (E950-959, E980-989)	242.88 (171.12-314.65)	64.82 (53.17-76.47)	15.59 (-2.05-33.22)	3.75 (2.65-5.30)	15.58 (4.84-50.16)		
Mental Disorders (290-318)	885.42 (746.49-1024.37)	479.90 (448.30-511.50)	207.20 (129.05-285.36)	1.85 (1.56-2.19)	4.27 (2.84-6.43)		
Injuries and Poisonings (E800-999)	2019.94 (1813.56-2226.32)	1307.59 (1256.13-1359.05)	819.79 (674.32-965.26)	1.54 (1.39-1.72)	2.46 (2.01-3.02)		
Diabetes (250)	212.43 (143.03-281.82)	53.41 (42.99-63.82)	16.52 (3.30-29.74)	3.98 (2.72-5.82)	12.86 (5.42-30.51)		
Chronic Obstructive Pulmonary Disorder (490-496)	251.05 (173.25-328.85)	181.54 (162.54-200.53)	163.80 (88.13-239.47)	1.38 (1.01-1.92)	1.53 (0.88-2.67)		
Coronary Heart Disease (410-414)	533.27 (418.55-648.00)	399.04 (371.20-426.89)	313.54 (208.15-418.93)	1.34 (1.07-1.68)	1.70 (1.14-2.53)		
Stroke (430-438)	204.29 (131.18-277.39)	154.18 (136.82-171.54)	112.29 (42.69-181.89)	1.33 (0.91-1.93)	1.82 (0.89-3.72)		
Cancer (140.0-239.9)	428.42 (323.46-533.38)	479.90 (448.30-511.50)	421.17 (302.02-540.31)	0.89 (0.69-1.15)	1.02 (0.70-1.48)		
Discrete Physician Visits*:							
Mental Disorders (290-318)	18419.05 (17790.80-19047.31)	14834.93 (14659.99-15009.87)	10324.28 (9830.58-10817.98)	1.24 (1.20-1.28)	1.77 (1.56-2.01)		
Injuries and Poisonings (E850-999)	19558.08 (18959.11-20157.05)	18513.29 (18316.76-18709.83)	14031.17 (13504.34-14558.00)	1.06 (1.03-1.09)	1.38 (1.08-1.76)		
Diabetes (250)	4080.39 (3767.89-4392.88)	2747.00 (2673.45-2820.56)	2295.18 (2034.59-2555.77)	1.49 (1.37-1.61)	1.77 (1.53-2.06)		
Chronic Obstructive Pulmonary Disorder (490-496)	10124.6 (9705.50-10543.70)	8272.19 (8140.86-8403.51)	5021.66 (4711.96-5331.36)	1.22 (1.17-1.28)	1.98 (1.84-2.13)		
Coronary Heart Disease (410-414)	2796.69 (2531.42-3061.96)	2650.73 (2578.79-2722.66)	2318.35 (2033.80-2602.91)	1.06 (0.96-1.16)	1.20 (1.04-1.39)		
Stroke (430-438)	694.13 (561.98-826.27)	813.33 (773.39-853.27)	694.71 (525.82-863.60)	0.85 (0.70-1.04)	1.00 (0.82-1.21)		
Cancer (140.0-239.9)	1716.09 (1508.69-1923.50)	2245.54 (2179.21-2311.87)	1947.55 (1694.75-2200.35)	0.76 (0.68-0.86)	0.88 (0.77-1.09)		
Overall Number of Physician Visits*:							
Mental Disorders (290-318)	94707.59 (93273.31-96141.87)	62232.75 (61875.27-62590.23)	41261.54 (40256.35-42266.74)	1.52 (1.51-1.53)	2.28 (2.12-2.45)		
Injuries and Poisonings (E850-999)	35776.38 (34953.35-36599.41)	26436.80 (26201.98-26671.62)	18444.12 (17845.01-19043.22)	1.35 (1.33-1.38)	1.91 (1.68-2.18)		
Diabetes (250)	15804.63 (15187.06-16422.20)	9244.56 (9109.66-9379.46)	7456.22 (6979.05-7933.39)	1.71 (1.64-1.78)	2.11 (1.92-2.32)		
Chronic Obstructive Pulmonary Disorder (490-496)	22853.39 (22234.48-23472.29)	15954.49 (15727.73-16136.25)	9277.95 (8840.36-9715.53)	1.43 (1.40-1.47)	2.42 (2.30-2.54)		
Coronary Heart Disease (410-414)	9978.65 (9474.00-10483.31)	8911.89 (8780.12-9043.65)	6893.25 (6391.47-7395.03)	1.12 (1.06-1.18)	1.44 (1.33-1.56)		
Stroke (430-438)	3776.37 (3465.53-4087.21)	4313.55 (4221.77-4405.33)	2391.42 (2080.32-2702.52)	0.88 (0.81-0.95)	1.58 (1.45-1.72)		
Cancer (140.0-239.9)	4027.99 (3708.07-4347.91)	5233.69 (5132.43-5334.95)	4005.07 (3644.51-4365.63)	0.77 (0.71-0.83)	1.00 (0.92-1.09)		
Medication Usage*:							
Mental Disorders	79154.85 (77823.42-80486.27)	65159.52 (64795.81-65523.23)	48990.73 (47871.85-50109.61)	1.21 (1.20-1.23)	1.62 (1.60-1.63)		
Diabetes	42902.94 (41889.07-43916.80)	23819.21 (23602.35-24036.07)	16491.26 (15793.52-17189.00)	1.80 (1.77-1.84)	2.60 (2.52-2.69)		
Public Health*:							
Chlamydia	1159.06 (1004.84-1313.27)	268.25 (244.33-292.17)	77.82 (35.52-120.12)	4.32 (3.68-5.07)	14.89 (8.51-26.06)		
Gonorrhea	300.33 (221.67-379.00)	38.71 (29.64-47.78)	0	7.76 (5.46-11.02)	n/a		
Hepatitis C (070.41, 44, 50, 54)	399.27 (307.04-491.49)	49.66 (39.46-59.86)	11.54 (-4.63-28.60)	8.04 (5.90-10.95)	34.60 (8.49-140.99)		
Vital statistics:							
Teen (15-19) Births†	98.13 (73.90-122.36)	23.33 (19.62-27.04)	5.95 (0.12-11.79)	4.21 (3.16-5.60)	16.49 (6.04-45.03)		
Low Birthweight (%)	9.2 (6.0-12.5)	6.3 (5.2-7.4)	8.4 (3.8-12.9)	1.46 (1.01-2.12)	1.10 (0.59-2.03)		
Mortality							
Infant Mortality†	20.83 (5.40-36.27)	3.80 (1.17-6.43)	6.45 (-6.19-19.10)	5.48 (2.00-15.02)	3.23 (0.40-26.02)		
All-cause Mortality	671.69 (548.93-794.46)	645.21 (609.79-680.62)	269.96 (164.15-375.81)	1.04 (0.86-1.26)	2.49 (1.62-3.83)		

* Age-standardized rate per 100,000 population

† Rate per 1000 live birth population

intervals were built around all rates. Rate ratios were computed for health care utilization data (hospital discharge, physician visit, medication usage) and incidence rate ratios were computed for incidence data (public health and vital statistics) for the year 2001.²¹ Rate ratios were computed between 1) the low-income neighbourhoods and the rest of Saskatoon and 2) the low-income neighbourhoods in comparison to the affluent neighbourhoods. Ninety-five percent confidence intervals were built around the rate ratios.

Health care utilization information submitted to the research team was de-identified and in aggregate form. The project received ethics approval from the University of Saskatchewan Behavioural Research Ethics Board.

RESULTS

In comparison to the rest of Saskatoon and the affluent neighbourhoods, the low-income neighbourhoods are significantly different in income status, education status and employment status (Table I). There were no statistically significant socio-economic differences between the six low-income neighbourhoods themselves or the five affluent neighbourhoods.

Comparing 2001 age-standardized hospital separations between the low-income neighbourhoods and the rest of Saskatoon, the rate ratio was significantly different for suicide attempts (RR=3.75), mental disorders (RR=1.85), injuries and poisonings (RR=1.54), diabetes (RR=3.98), chronic obstructive pulmonary disease or COPD (RR=1.38) and coronary heart disease or CHD (RR=1.70). Comparing the low-income to the affluent neighbourhoods, significant differences were observed for suicide attempts (RR=15.58), mental disorders (RR=4.27), injuries and poisonings (RR=2.46), diabetes (RR=12.86) and CHD (RR=1.70). There were no statistically significant

cant differences observed for stroke or cancer (Table II).

For overall number of physician visits in 2001, the rate ratio between the low-income neighbourhoods and the rest of Saskatoon had significant differences for mental disorders (RR=1.52), injuries and poisonings (RR=1.35), diabetes (RR=1.71), COPD (RR=1.43) and CHD (RR=1.12). Comparing the low-income to the affluent neighbourhoods, significant rate ratios were observed for mental disorders (RR=2.28), injuries and poisonings (RR=1.91), diabetes (RR=2.11), COPD (RR=2.42), CHD (RR=1.44) and stroke (RR=1.58). Overall cancer treatments by physicians were lower in the low-income neighbourhoods in comparison to the rest of Saskatoon (RR=0.77) (Table II).

The rate ratio for prescriptions filled for mental disorders in the low-income neighbourhoods to the rest of Saskatoon was significant (RR=1.21) as was diabetes medications (RR=1.80). Comparing the low-income to the affluent neighbourhoods, significant differences were observed for both mental disorders (RR=1.62) and diabetes medications (RR=2.60) (Table II).

Reviewing public health information, we found that comparing the low-income neighbourhoods to the rest of Saskatoon resulted in incidence rate ratios of 4.32 for chlamydia, 7.76 for gonorrhoea and 8.04 for hepatitis C. Comparing the low-income to the affluent neighbourhoods, the rate ratio for chlamydia was 14.89 and 34.60 for hepatitis C. There was no gonorrhoea diagnosed in the affluent neighbourhood in 2001 (Table II).

Significant differences were observed in rate ratios comparing the low-income neighbourhoods to the rest of Saskatoon for teen births (RR=4.21), low birthweight (RR=1.46) and infant mortality (RR=5.48). Significant differences were also found comparing the low-income to the affluent neighbourhoods for teen births (RR=16.49), low birthweight (RR=1.10), infant mortality (RR=3.23) and all-cause mortality (RR=2.49) (Table II).

DISCUSSION

Previous reports have found associations between neighbourhood socio-economic status and all-cause mortality, infant mor-

tality, infant birthweight, suicide, long-term illness, coronary heart disease, disability, chronic conditions and depression.^{11,13} The neighbourhood effects found in previous multivariate analysis studies that control for individual SES are modest and at times contradictory.^{9,11-16,22}

The investigators reviewed cross-sectional ecological data to determine the association between neighbourhood income and health care utilization in the city of Saskatoon. Significant differences were found for suicide attempts, mental disorders, injuries and poisonings, diabetes, chronic obstructive pulmonary disease, coronary heart disease, chlamydia, gonorrhoea, hepatitis C, teen birth, low birthweight, infant mortality and all-cause mortality. The rates ratios were larger when comparing low-income to high-income neighbourhoods. No clear or consistent pattern was observed for stroke or cancer. This finding for cancer has been demonstrated previously.⁷

There are several limitations that must be discussed. First, the study design is cross-sectional. Any finding must be seen as associative and not cause and effect. Second, information on individual income was not collected. The study design was not intended to review the independent effect of neighbourhood income while controlling for individual income status or other covariates. Third, the study only gathered data on those who presented to health care and as such there is no way of knowing true disease prevalence or incidence. Finally, the authors do not address the issue of selection: does income cause health or does health cause income?

Most researchers conclude that where you live matters to health but not as much as who you are.²³ Rather than being a single universal neighbourhood effect on health, there appears to be some area effects on some health outcomes, in some population groups, and in some types of areas.²³ That said, Canadian neighbourhoods have become increasingly polarized along income lines.¹⁴ As a result, neighbourhoods might become more important in explaining health inequalities in the future.¹⁴ In Saskatoon, low-income neighbourhoods were associated with increased health care utilization and, as such, neighbourhoods might have an important independent effect in a

multivariate model currently being developed.

In summary, one review suggests Canada still has a poor conceptualization of the influence of income on health.²⁴ The current study represents a simple yet effective way to assess and quantify the magnitude of health disparity in an urban setting. The findings suggest that low-income neighbourhoods are associated with increased health care utilization in Saskatoon.

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RÉSUMÉ

Contexte : Les villes canadiennes sont de plus en plus compartimentées selon le revenu, d'où l'intérêt d'étudier l'ampleur des disparités sur le plan de la santé entre les quartiers à revenu faible, moyen et élevé pour quantifier les niveaux de disparité sur le plan de la santé à l'échelle d'une ville.

Méthode : À l'aide d'une étude écologique transversale, nous avons examiné toutes les sorties d'hôpitaux, les visites chez le médecin, la consommation de médicaments, l'information de santé publique et les statistiques démographiques d'une ville entière selon le revenu de ses quartiers. Le code postal a servi à circonscrire six quartiers résidentiels contigus dans la ville de Saskatoon définis comme étant en-dessous du seuil de faible revenu (N=18 228). Nous avons utilisé deux groupes témoins : tous les autres résidents de Saskatoon (N=184 284) et les habitants des cinq quartiers les plus aisés de Saskatoon (N=16 683).

Constatations : Nous avons observé des écarts significatifs dans l'utilisation des soins de santé selon le revenu du quartier en ce qui concerne les tentatives de suicide, les troubles mentaux, les blessures et les empoisonnements, le diabète, les bronchopneumopathies chroniques obstructives, les cardiopathies ischémiques, les chlamydioses, la gonorrhée, l'hépatite C, les accouchements à l'adolescence, l'hypotrophie néonatale, la mortalité infantile et la mortalité toutes causes confondues. Les ratios des taux étaient plus élevés dans les quartiers à faible revenu que dans les quartiers aisés. Aucune tendance claire n'a cependant été observée pour les accidents vasculaires cérébraux, ni pour les cancers.

Interprétation : Ces constatations donnent à penser que les quartiers à faible revenu sont associés à une utilisation accrue des soins de santé à Saskatoon.

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