RESEARCH REPORT

Labour market income inequality and mortality in North American metropolitan areas

C Sanmartin, N A Ross, S Tremblay, M Wolfson, J R Dunn, J Lynch

J Epidemiol Community Health 2003;**57**:792–797

See end of article for authors' affiliations

Correspondence to: Claudia Sanmartin, Health Analysis and Measurement Group, Statistics Canada, RH Coats Bldg, 24th Floor Section R, Ottawa, Canada K1A 0T6; claudia.sanmartin@statcan.ca

Accepted for publication 5 March 2003

Objective: To investigate relations between labour market income inequality and mortality in North American metropolitan areas.

Methods: An ecological cross sectional study of relations between income inequality and working age (25–64 years) mortality in 53 Canadian (1991) and 282 US (1990) metropolitan areas using four measures of income inequality. Two labour market income concepts were used: labour market income for households with non-trivial attachment to the labour market and labour market income for all households, including those with zero and negative incomes. Relations were assessed with weighted and unweighted bivariate and multiple regression analyses.

Results: US metropolitan areas were more unequal than their Canadian counterparts, across inequality measures and income concepts. The association between labour market income inequality and working age mortality was robust in the US to both the inequality measure and income concept, but the association was inconsistent in Canada. Three of four inequality measures were significantly related to mortality in Canada when households with zero and negative incomes were included. In North American models, increases in earnings inequality were associated with hypothetical increases in working age mortality rates of between 23 and 33 deaths per 100 000, even after adjustment for median metropolitan incomes.

Conclusions: This analysis of labour market inequality provides more evidence regarding the robust nature of the relation between income inequality and mortality in the US. It also provides a more refined understanding of the nature of the relation in Canada, pointing to the role of unemployment in generating Canadian metropolitan level health inequalities.

There is now a large and quickly evolving literature on the relation between income inequality and health conducted at a number of geographical scales including country,[1–4] state,[5–9] and metropolitan level.[10 11] Most of the studies apply ecological level analyses of household incomes after government transfers and before taxes (that is, post-transfer pre-tax income). One of the most compelling of these studies has been a natural experiment comparing metropolitan areas (MAs) in Canada and the United States.[11] This analysis demonstrated that Canadian MAs had much lower income inequality and lower mortality than their American counterparts. The analyses revealed a strong relation between income inequality and mortality in the US, independent of the effect of absolute income. However, there was no such relation among Canadian MAs.

One interpretation of the null finding for Canada may be that government transfer payments mask the relation by reducing inequalities in total income (post-transfer, pre-tax income). In other words, it is possible that health compromising inequality in Canada may exist in the labour market even though transfer payments have served to keep overall income inequality from rising in Canada, at least since 1971.[12] Indeed, inequalities in labour market income have risen steadily since about 1980 in Canada while inequalities in post-transfer, pre-tax and disposable household incomes have remained constant (fig 1). In their study of 13 OECD countries including Canada and the United States, Oxley *et al* point out that income inequality has increased in many OECD countries due to inequalities in labour market income. These increases did not necessarily translate into higher inequality in disposable incomes, however, as government sponsored transfers and taxes were able to offset the effects of earnings and self employment income inequalities.[13] It may be that inequalities are experienced in localities where there are large differences in labour market incomes even though taxes and transfer payments serve to partly equalise household material resources.

The primary purpose of this paper is to investigate the relation between labour market income inequality and working age mortality among North American MAs. Labour market income inequality may exist because of highly dispersed incomes among those working, or may be between the employed and the unemployed. We hypothesise that dispersed incomes generated by very high and very low salaries and wages are the primary drivers of labour market inequality in the US, because the bottom of the income distribution in the US is characterised by large numbers of households with low wage jobs. In contrast, unemployment plays a relatively larger part in inequalities existing among Canadian MAs because in Canada, US style low wage jobs are much less common. Put simply, low income in the US is a marker for low wage employment, while low income in Canada is a marker for labour market exclusion and unemployment. To assess these relations, two income concepts, non-trivial earned income (NTEI) and all earned income (AEI), are expressed in a suite of income inequality measures. As exposures, NTEI is conceptualised to represent income inequality among households attached to the labour market with more than $1000 of annual earnings, while the AEI measure additionally includes households with zero or negative earned incomes. These households are primarily comprised of those excluded from labour market earnings. While it has been argued that the type of inequality measure

Abbreviations: MA, metropolitan area; NTEI, non-trivial earned income; AEI, all earned income

Figure 1 Trends in the Gini coefficient by income type in Canada 1971–1997. Source: Survey of consumer finance, Statistics Canada, Custom Tabulation.

does not matter in studies linking income inequality and mortality,[14] we take the approach that the measures used here are sensitive to different parts of the income distribution and it is important to understand how these subtleties influence the relation with mortality, especially in a cross national study comparing countries with differing income distributions.

METHODS

Data sources

The association between income inequality and mortality was analysed for households headed by a working aged adult between 25 and 64 years of age in 53 Canadian and 282 US MAs with populations greater than 50 000 in 1991 (Canada) and 1990 (US). Income inequality measures for Canadian MAs were derived from a specially prepared micro data file of the 2B sample of the 1991 census of population. The 2B sample represents information gathered from 20% of Canadian households who responded to the long form questionnaire, which includes detailed information about the sources of household income. The mortality data were obtained from Statistics Canada's vital statistics and are based on three year averages (1990–92) by MA. Unemployment rates for the Canadian MAs were obtained from the Statistics Canada Labour Force Survey for 1991.

Income inequality measures for the US MAs were derived from a special tabulation of the full 1 in 6 sample of the 1990 census, also commonly known as the long form, which asks detailed information on income sources. Data files for both countries contain 32 income categories with the highest category representing household incomes greater than $250 000. The chief advantage of the specially prepared files for both countries was that there was no top-coding of high incomes, thereby allowing for the specification of very accurate measures of inequality. Metropolitan mortality rates for the US were provided by Lynch and colleagues and were standardised to the Canadian population in 1991.[4] Unemployment rates for the US MAs were obtained from the 1990 Census Lookup feature of the Census Bureau web site.

Definitions of labour market income concepts

Two income concepts were used to capture the differing effects of both dispersed incomes and unemployment on inequality and mortality. The following income concepts were measured at the household level:

- Non-trivial earned income (NTEI): earnings from wages, salary and farm and non-farm self employed income for all households reporting annual earnings of $1000 or more. This income concept excludes those with trivial labour market earnings (that is, <$1000), the unemployed and those reporting negative incomes. This approach succeeds in eliminating those households who have effectively no significant attachment to the labour market.[12]
- All earned income (AEI): earnings from wages and salary and farm and non-farm self employed income for all households including those households with trivial earnings, zero earned income and those reporting negative incomes. This income concept is used to capture the potential effects of including the unemployed households as part of the income distribution in generating metropolitan level inequalities.

Definitions of income inequality measures

Income inequality was estimated using a variety of measures, which, by design, have properties that emphasise different aspects of the income distribution. The Gini coefficient is a global measure of income inequality that is sensitive to the proportion of households in the middle income groups. Similarly, the median share, while a point estimate, is also sensitive to the middle of the income distribution. The coefficient of variation (CV) is sensitive to the upper end of the distribution, giving increased weight to higher income households, while the exponential measure mathematically weights the near-zero income households most heavily giving more emphasis to inequality generated by very low income groups within MAs.

Additional details are provided below[15]:

- Gini coefficient: a global measure of the degree of deviation of the income distribution from ''perfect equality'' where each proportion of households controls a proportionately equal amount of resources. The Gini coefficient is calculated using the Lorenz curve and ranges in value between 0 (perfect equality) and 1 (perfect inequality).
- Median share: a measure of the proportion of total household income accruing to the least well off 50% of households. In a situation of perfect equality, the median share would equal 0.50, and so higher median share values indicate more equal income distributions.
- Coefficient of variation (CV): a measure of the dispersion of incomes in a defined area. The CV reflects the average deviation from the mean income as a proportion of the average income. A higher CV reflects a more dispersed and often unequal distribution of income.
- Exponential: a bottom sensitive measure of income inequality reflecting the distance from the average income with more weight placed on income values below the mean. Higher exponential values indicate higher levels of inequality.

Unweighted and weighted correlation analyses were used to assess the association between the income inequality measures for each income concepts. Weighted multiple linear regression models were used to analyse the relation between income inequality and mortality by income concept and inequality measure both within a North American model and separately for each country. Weighted (by MA population size) regression analyses adjusting for median household income and unemployment are also provided. For a more in depth discussion of the weighting see Lynch *et al*[10] and Ross *et al*.[11] The regression analyses were based on standardised measures of income inequality to allow more direct compar-

isons of the regression coefficients across inequality measures.

RESULTS

The MAs in the US (n = 282) ranged in population between 56 735 (Enid, Oklahoma) and 18 087 251 (New York City, NY) with a median population of 242 847. In Canada MAs (n = 53) ranged between 50 193 (Saint-Hyacinthe, Quebec) and 3 893 046 (Toronto, Ontario) with a median population of 116 100. Working age mortality rates varied in the US from 237 per 100 000 in Rochester (MN) to 571 per 100 000 in Florence (SC). In Canada, working age mortality rates ranged between 244 per 100 000 in Abbotsford (BC) and 400 per 100 000 in Prince George (BC).

Bivariate analyses of inequality measures

Income inequality measures were highly correlated in North America for NTEI. The unweighted and weighted Pearson *r* values ranged between 0.80 and 0.99 and between 0.76 and 0.99 respectively. All correlations were significant at the $p<0.01$ level. As expected, the association between middle sensitive measures (that is, the median share and the Gini) was strong for both analyses (unweighted and weighted: $r = -0.98$). Similarly, a strong association existed between the middle sensitive measures and the exponential (bottom sensitive) measure. Correlations between the median share and CV values were the weakest (unweighted: $r = -0.80$; weighted: $r = -0.76$) but still significant.

When inequality measures were analysed within countries, the type of inequality measure had a modest effect on the rank order of MAs. For instance, in the US, Sheboyagan (WI) and Mcallen (TX) were consistently ranked as the most and least equal MAs, respectively, for three of the four NTEI inequality measures. In Canada, Oshawa (ON) and Barrie (ON) consistently appeared as the most equal cities while Kelowna (BC) and Sydney (NS) ranked as the most unequal places, regardless of the inequality measure used. In both countries, the greatest variation in rank order occurred with the CV measure.

Labour market income inequality

The US MAs were consistently more unequal than their Canadian counterparts. This was especially evident with the top sensitive CV measure. The average CV values for US MAs were 0.90 and 0.99 for NTEI and AEI inequality, respectively, compared with 0.70 and 0.82 for Canadian MAs (table 1).

As expected, MAs appear more equal when the non-trivial earned income concept is used to measure inequality (table 1). The average NTEI median share for US MAs was 0.25, approximately 17% higher than the average AEI median share (0.21). The Gini coefficient and the CV also showed the same pattern: greater average inequality in the all earnings measures compared with the non-trivial earnings measures among US MAs.

Among Canadian MAs, the average NTEI median share was 0.26, 24% higher than the average AEI median share (0.21). Average AEI Gini coefficient and CV values were 20% and 17% higher respectively compared with measures based on NTEI. There was less variability for the exponential across income concepts in both Canada and the US

A combined US and Canada model

Labour market income inequality was a significant explanatory factor for working aged mortality in US and North American-wide models even after adjusting for median household income (table 2). For NTEI inequality, the effect of income inequality on working age mortality, after adjusting for median income, varied slightly across inequality measures. The coefficients may be interpreted as follows: a hypothetical 1 standard deviation increase in inequality is associated with an increase in the mortality rate of between 25 and 26 deaths per 100 000 population, depending on the inequality measure. Explained variation in these models did not exceed 20%. When Canadian MAs were added to the model, there were significant gains in the explained variation with adjusted r^2 values increasing to approximately 0.40. (table 2). The increase in r^2 is due in large part to the fact that the addition of the dummy variable accounting for the long standing mortality differences between Canada and the US is an effective explanatory variable. Labour market income inequality remains an important and significant explanatory variable in the final combined model.

The results were similar for the AEI models (table 2). The effects of labour market inequality on mortality were slightly higher when AEI was considered, ranging from 29 to 33 deaths per 100 000 population, after adjusting for median income. Adjusted r^2 values ranged between 0.23 (CV) and 0.33 (median share and Gini). Once again, the addition of the Canadian MAs increased the explanatory power of the combined model with adjusted r^2 values increasing to between 0.43 (CV) and 0.51 (median share and Gini).

US compared with Canada

When the association between labour market inequality and mortality was assessed for each country separately, the association was significant and in the hypothesised direction for the US MAs for both NTEI and AEI income concepts (table 3). For NTEI, models with median share ($\beta = -24.03$; $p<0.01$), Gini coefficient ($\beta = 24.85$; $p<0.01$), CV ($\beta = 22.23$; $p<0.01$) and exponential ($\beta = 22.21$; $p<0.01$) were all significant with adjusted r^2 values between 0.16 (CV) and 0.20 (Gini). The estimated effects on mortality, therefore, were between 23 and 24 deaths per 100 000 per one standard deviation increase in inequality. The results were similar for AEI inequality with estimated increases in mortality ranging from 25 (CV) to 31 (Exp) deaths per 100 000 for each standard deviation increase in inequality. Explained variation in mortality was slightly higher than the NTEI models with r^2 values ranging from 0.22 (CV) and 0.31 (Gini).

Table 1 Average measure of income inequality by type of inequality measure and labour market income concept, Canada and US Metropolitan areas, 1990/91 (standard deviation)

	Median share	Gini	CV	Exp
US metropolitan areas (n = 282)				
NTEI	0.25 (0.02)	0.38 (0.02)	0.90 (0.11)	0.45 (0.01)
AEI	0.21 (0.02)	0.43 (0.03)	0.99 (0.12)	0.47 (0.01)
Canadian metropolitan areas (n = 53)				
NTEI	0.26 (0.01)	0.34 (0.01)	0.70 (0.05)	0.44 (0.01)
AEI	0.21(0.02)	0.41 (0.03)	0.82 (0.06)	0.47 (0.01)

Table 2 Regression results for labour market income inequality and working age mortality, North American metropolitan areas (n = 335), 1990/91

	Non-trivial earned income (>$1000)				All earned income			
Income inequality	**Intercept**	**Income inequality**	**Canada flag**	**Adj r^2**	**Intercept**	**Income inequality**	**Canada flag**	**Adj r^2**
Median share								
US only	407**	−24.0**	–	0.18	401**	−29.3**	–	0.29
US adjusted	408**	−24.5**	–	0.18	402**	−33.3**	–	0.33
US and Canada	407**	−22.6**	−94.7**	0.40	402**	−32.3**	−126.8**	0.51
Gini								
US only	399**	25.9**	–	0.20	400**	29.9**	–	0.31
US adjusted	399**	26.0**	–	0.20	401**	31.7**	–	0.33
US and Canada	399**	24.8**	−81.4**	0.41	401**	30.9**	−106.9**	0.51
Coefficient of variation								
US only	397**	25.6**	–	0.16	398**	27.7**	–	0.22
US adjusted	398**	26.0**	–	0.16	398**	29.1**	–	0.23
US and Canada	398**	24.3**	−69.1**	0.38	398**	28.1**	−75.7**	0.43
Exponential								
US only	399**	24.7**	–	0.17	400**	30.6**	–	0.30
US adjusted	400**	24.7**	–	0.17	401**	32.5**	–	0.32
US and Canada	400**	23.7**	−82.1**	0.39	401**	31.7**	−110.5**	0.50

**Significant at p<0.01. Standardised regression coefficients adjusted for median metropolitan area household income; analyses weighted by metropolitan area population size).

In Canada, however, the results varied by both income concept and inequality measure. The association was not significant for NTEI bottom and middle sensitive measures (fig 2). Labour market inequality, however was significantly associated with mortality for NTEI inequality CV (β = −10.8; p<0.05), but not in the hypothesised direction. This counter-intuitive result may be a function of the limited variability in CV values within Canadian MAs. Overall, CVs in Canada cluster at the lower range between 0.58 and 0.80 compared to values in the US in which there is a twofold difference between the lowest (0.70) and highest (1.44) CV values. Higher CV values for US MAs are due to the higher concentration of earned income in the upper income category (>$250 000). In the US, about 4% of the total earnings can be attributed to households in the top income category, compared with only 2% in Canada. The higher CVs in Canada occur almost exclusively in the larger cities where diversified labour markets generate higher and more dispersed earnings. In smaller MAs incomes tend to be lower and less dispersed (hence lower CVs), but smaller MAs in Canada also tend to have higher mortality rates. It sets up the possibility of the coexistence of relatively high earnings inequality (especially as measured by the top-sensitive CV) and relatively low mortality in large Canadian MAs.

There was a significant association between AEI inequality and mortality in Canada for the median share (β = −14.4; p<0.01), the Gini (β = 11.2; p<0.01) (fig 2), and the EXP (β = 12.6; p<0.01), with r^2 values ranging from 0.18 to 0.27 (table 3). In subsequent regression analyses (table 4), the association between AEI inequality and mortality disappeared in Canada when unemployment was added to the model. As expected, unemployment was significantly associated with mortality (β = 15.5; p<0.05) and the adjusted r^2 increased to 0.31 but the income inequality measure (in this case the Gini coefficient) was no longer significant. For the US MAs, AEI inequality remained significantly associated with mortality even when unemployment rates were added to the model.

DISCUSSION

Our analysis of earned income inequality has revealed the effects of various aspects of the labour market in generating inequalities among MAs in both the US and Canada. US MAs had greater earnings inequality and higher mortality rates than their Canadian counterparts, consistent with previous analyses.[11] In both countries, as expected, MAs appeared more equal when a non-trivial earned income definition was used to represent inequality among high and low earners. Metropolitan areas demonstrated higher levels of inequality when all earned income was used—that is, including zero and negative incomes—pointing to the potential effect of unemployment in generating labour market inequalities.

Results of the weighted regression analyses suggested that both the type of measure and type of income matter for accounting for metropolitan scale mortality patterns in Canada but not in the United States. The relation between income inequality and mortality was consistent (significant and same direction) in the US regardless of the type of measure or income concept used. US models explained between 16% and 30% of the variation in working aged

Table 3 Summary of the association between income inequality and mortality by labour market income concept and inequality measure, Canada and US metropolitan areas

	Canada (n = 53)				US (n = 282)			
	Non-trivial earned income		All earned income		Non-trivial earned income		All earned income	
Inequality measure	**β**	**Adj r^2**	**β**	**Adj r^2**	**β**	**Adj r^2**	**β**	**Adj r^2**
Median share	6.7	0.04	−14.4**	0.27	−24.03**	0.18	−29.3**	0.29
Gini	−6.0	0.06	11.2**	0.18	24.85**	0.20	29.9**	0.31
CV	−10.8**	0.14	2.3	−0.01	22.23**	0.16	25.5**	0.22
Exponential	−4.6	0.03	12.6**	0.22	22.21**	0.17	30.64**	0.30

**Significant at p<0.01. Standardised regression coefficients; analyses weighted by metropolitan area population size).

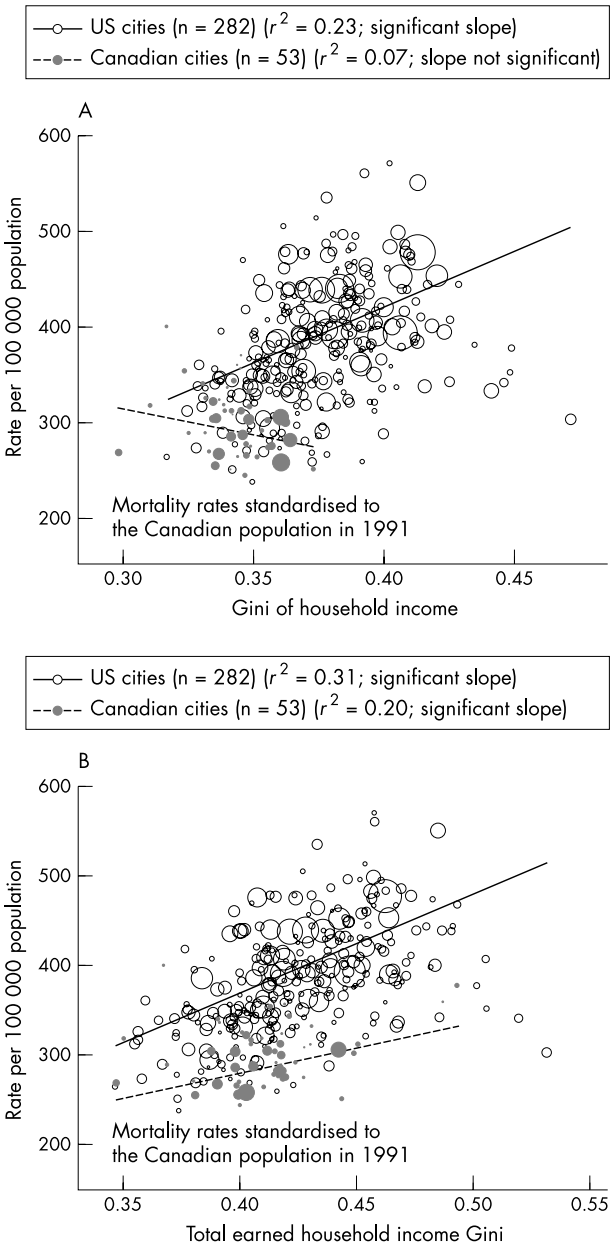

Figure 2 Working age mortality by Gini coefficient for non-trivial earned income (A) and all earned income (B) with weighted linear fit.

mortality, even after adjustments were made for median household income and unemployment.

In Canada, however, the association between income inequality and mortality varied depending on the income concept and inequality measure used despite the fact that the inequality measures were highly correlated. Our analysis of labour market income inequalities provides new evidence regarding this association and the role of labour market inequality resulting from unemployment in accounting for metropolitan scale patterns of working age mortality in Canada. While both concepts of earnings inequality (all and non-trivial earnings) were influential in accounting for the geographical variation of metropolitan scale mortality in the US, geographical variation in Canada was accounted for only after the inclusion of the most economically vulnerable households in the calculation of income inequality. Indeed, the inclusion of the unemployment rates into models of Canadian MA mortality removed the effect of all earned income inequality.

Our findings could be interpreted as showing that to better understand the geographical distribution of mortality across Canada, it is important to include information on the role of labour market exclusion. In the US this is not the case. Ecological fallacy aside, in the US it appears to make no difference if labour market exclusion is considered or not, perhaps because of the nature of the US labour market where there is less distinction—at least in terms of mortality risk—between being employed in a low wage job at the bottom of the earnings distribution and being unemployed. In epidemiological terms, these results can be understood as the effects of truncating the exposure distribution. Whatever the mechanism involved, patterns of health vulnerability of the US population are still revealed by truncating the earnings distribution (that is, excluding the unemployed households), but this is not so for patterns of health vulnerability in Canada.

Key points

- Labour market income inequality and mortality rates in metropolitan areas in the US were consistently higher than in Canada.
- The labour market income inequality gap between the two countries was most obvious when applying a top sensitive inequality measure, reflecting the relatively large share of earnings held by the highest income category in the US compared with Canada.
- Labour market income inequality was a significant explanatory factor for working aged mortality in all US and North American-wide models even after adjusting for median household income. The findings were inconsistent for Canadian metropolitan areas.
- This is the first finding to date to suggest a role of inequality generated by labour market exclusion in accounting for urban working age mortality patterns in Canada. The conceptualisation of income inequality is thus important for epidemiological studies of this kind.

Table 4 Summary of the association between income inequality, unemployment, and mortality for all earned income (AEI), Canada and US metropolitan areas

	Canada (n = 52)				US (n = 28)			
	Intercept	Gini	Unemployment	Adj r^2	Intercept	Gini	Unemployment	Adj r^2
Gini	286**	11.2**	–	0.18	401**	29.9**	–	0.31
Gini and unemployment	287**	1.33	14.8**	0.32	401**	33.3**	−6.3	0.31

**Significant at p<0.01. Standardised regression coefficients; analyses weighted by metropolitan area population size).

Policy implications

- In these cross sectional, ecological analyses, labour market income inequality is an important explanatory factor for the pattern of working age mortality in North American metropolitan areas. The hypothetical effects are indeed large from a public health point of view and therefore suggest that any number of policies aimed at the amelioration of inequalities in the labour market could prove important for population health.

There is an extensive literature linking unemployment to poor health outcomes in individuals.[16 17] Bartley's[18] review outlined a number of mechanisms that might account for the consistent relation between unemployment and health and they are very similar to the types of explanations often offered up linking income inequality to poor health: the role of relative poverty, social isolation/loss of self esteem and the creation of cultures of risky health behaviours.[19–21] Thus it would appear that whether the statistical relation is between unemployment or income inequality, the mechanisms thought to increase the risk of adverse health are very similar and could probably be approached in much the same way from a policy perspective.

The findings of this study echo those of previous ecological studies investigating the relation between income inequality and mortality. They also provide a more refined understanding of the role of labour market generated inequality among Canadian MAs. Many argue, however, that the best approach to studying social environmental determinants of health is with a study design that simultaneously accounts for known health determinants at the individual and ecological scales. Recent studies have adopted a multi-level approach to tease out the net effects on health of societal level inequality, while controlling for individual characteristics such as income and employment status.[22–24] The results of these studies are mixed (for a review see Wagstaff and van Doorslaer),[25] perhaps because of variations in sample sizes of the studies and the variety of geographical scales at which income inequality is measured. In cross national studies, however, a multi-level approach is often not possible as individual level health data are rarely comparable across countries.

On balance, the evidence from both ecological and multi-level study designs is suggestive of a role of income inequality, and labour market inequality, for the health of Americans but not consistently for the health of Canadians. Mortality, however, is affected by a wide range of factors, both individual and ecological. There is still a role for more refined ecological level comparisons of mortality between the US and Canada. These comparisons should take into account additional socioenvironmental factors to determine their influence along with the effects of income inequality and recognise that the relevant factors may differ in each country.

Authors' affiliations
C Sanmartin, S Tremblay, Health Analysis and Measurement Group, Statistics Canada, Ottawa, Canada
N A Ross, Department of Geography, McGill University, Associate, Health Analysis and Measurement Group, Statistics Canada, Montreal, Canada
M Wolfson, Statistics Canada
J R Dunn, Department of Community Health Sciences, University of Calgary, Canada
J Lynch, School of Public Health, University of Michigan, Ann Arbor, USA

Funding: the research is funded by a grant from the Canadian Population Health Initiative (CPHI). CS is supported by a Statistics Canada postdoctoral award. NAR has a New Investigator salary award from the Canadian Institutes of Health Research (CIHR). JRD also has a New Investigator award from CIHR and salary support from the Alberta Heritage Foundation for Medical Research (AHFMR). JL is supported by a Robert Wood Johnson Health Investigator Award.

REFERENCES

1 **Rodgers GB**. Income and inequality as determinants of mortality: an international cross section analysis. *Population Studies* 1979;**33**:343–51.
2 **Wilkinson RG**. Income distribution and life expectancy. *BMJ* 1992;**304**:165–8.
3 **Orcott-Duleep H**. Mortality and income inequality among economically developed countries. *Social Security Bulletin* 1995;**58**:34–50.
4 **Lynch J**, Davey Smith G, Hillemeier M, *et al*. Income inequality, the psychosocial environment, and health: comparisons of wealthy nations. *Lancet* 2001;**358**:194–200.
5 **Kaplan GA**, Pamuk ER, Lynch JW, *et al*. Inequality in income and mortality in the United States: analysis of mortality and potential pathways. *BMJ* 1996;**312**:999–1003.
6 **Kennedy BP**, Kawachi I, Prothrow-Stith D. Income distribution and mortality: cross sectional ecological study of the Robin Hood index in the United States. *BMJ* 1996;**312**:1004–7.
7 **LeClere FB**, Soobader MJ. The effect of income inequality on the health of selected US demographic groups. *Am J Public Health* 2000;**90**:1892–7.
8 **Kennedy BP**, Kawachi I, Glass R, *et al*. Income distribution, socioeconomic status, and self-rated health in the United States: multilevel analysis. *BMJ* 1998;**317**:917–21.
9 **Kahn RS**, Wise PH, Kennedy BP, *et al*. State income inequality, household income, and maternal mental and physical health: cross sectional national survey. *BMJ* 2000;**321**:1311–15.
10 **Lynch JW**, Kaplan GA, Pamuk ER, *et al*. Income inequality and mortality in metropolitan areas of the United States. *Am J Public Health* 1998;**88**:1074–80.
11 **Ross NA**, Wolfson MC, Dunn JR, *et al*. Relation between income inequality and mortality in Canada and in the United States: cross sectional assessment using census data and vital statistics. *BMJ* 2000;**320**:898–902.
12 **Wolfson MC**, Murphy BB. New views on inequality trends in Canada and the United States. *Monthly Labor Review* 1998;April:3–23.
13 **Oxley H**, Burniaux JM, Dang TT, *et al*. Income distribution and poverty in 13 OECD countries. *OECD Economic Studies* 1999;**29**:1997/II.
14 **Kawachi I**, Kennedy BP. The relationship of income inequality to mortality: does the choice of indicator matter? *Soc Sci Med* 1997;**45**:1121–7.
15 **Gunderson M**. *Economics of poverty and income distribution*. Toronto: Butterworths, 1983.
16 **Haynes R**, Bentham G, Lovett A, *et al*. Effect of abour market conditions on reporting of limiting long term illness and ermanent sickness in England and Wales. *J Epidemiol Community Health* 1997;**51**:283–8.
17 **Jin RL**, Shah CP, Svoboda TJ. The impact of unemployment on health. A review of the evidence. *CMAJ* 1996;**154**:1467–8.
18 **Bartley M**. Unemployment and ill health: understanding the relationship. *J Epidemiol Community Health* 1994;**48**:333–7.
19 **Lynch JW**, Kaplan GA. Understanding how inequality in the distribution of income affects health. *Journal of Health Psychology* 1997;**2**:297–314.
20 **Lynch JW**, Davey Smith G, Kaplan GA, *et al*. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *BMJ* 2000;**320**:1200–4.
21 **Wilkinson RG**. *Unhealthy societies: the afflictions of inequality*. London: Routledge, 1997.
22 **Daly MC**, Duncan GJ, Kaplan GA, *et al*. Macro- to micro links in the relation between income inequality and mortality. *Milbank Q* 1998;**76**:315–37.
23 **Subramanian SV**, Kawachi I, Kennedy BP. Does the state you live in make a difference? Multilevel analysis of self-rated heath in the United States. *Soc Sci Med* 2001;**53**:9–19.
24 **Blakely TA**, Lochner K, Kawachi I. Metropolitan area income inequality and self-rated health – a multilevel study. *Soc Sci Med* 2002;**54**:65–77.
25 **Wagstaff A**, van Doorsalaer G. Income inequality and health: what does the literature tell us? *Annu Rev Public Health* 2000;**21**:543–67.