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Economy, community and mortality in British Columbia, Canada

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Abstract

Stimulated by the growing body of literature relating economic inequalities to inequalities in health, this article explores relationships between various economic attributes of communities and mortality rates among 24 coastal communities in British Columbia, Canada. Average household income, a measure of community wealth, was negatively related and the incidence of low incomes, a measure of poverty, was positively related to age-standardized mortality. Both were more strongly related to female than male mortality. Mean and median household income, the incidence of low incomes and a lack of disposable income, and the proportion of total income dollars derived from government sources were significantly related to mortality rates for younger and middle-aged men but not for elderly men. Mortality rates for younger and middle-aged women were not explicated by these economic attributes of communities: among elderly women only, mortality rates were higher in communities with a lower average household income and in those with a higher incidence of low incomes. Finally, a higher concentration in white-collar industries was related to higher mortality rates for females, even after controlling for other economic attributes of communities. These results do not obviously support a psychosocial argument for an individual-level relationship between income and health that assumes residents perceive their status primarily in relation to other members of the same community, but do provide moderate support for the materialist argument and moderate support for the psychosocial argument that assumes community residents perceive their status in relation to an encompassing reference group. Other viable interpretations of these relationships pertain to ecological characteristics of communities that are related to both economic well-being and population health status; in this instance, concentration in specific economic industries may help to understand the ecological relationships presented here.

Keywords: Economic prosperity; Economic industry; Community wealth; Poverty; Population health; Mortality rates; Canada

Introduction

The economic resources of people and communities are a particularly potent determinant of health. This article explores relationships between various economic attributes of communities, including community wealth, the incidence of poverty and the nature of economic industry, and population health, i.e. mortality rates, among coastal communities in British Columbia, Canada. Such relationships can be explained with either of individual-level and ecological interpretations, the plausibility of which are speculated upon herein.

Income and health

It is well known that income matters for health. At the level of the individual, income has been found to be related to various measures of health status within many, if not all, Western countries (e.g. Feinstein, 1993; Adler et al., 1994; Charlton & White, 1995; Fein, 1995; James, Nelson, Ralph, & Leather, 1997; Macintyre, 1997). This is certainly the case in the United States (Rogot, Sorlie, & Johnson, 1992; Backlund, Sorlie, & Johnson, 1996) and in Canada (e.g. Wolfson, Rowe, Gentleman, & Tomiak, 1993; Denton & Walters, 1999; Wood, Sallar, Schecter, & Hogg, 1999; Humphries & van Doorslaer, 2000; Veenstra, 2000). This relationship

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appears to be curvilinear (Backlund et al., 1996; Judge, Mulligan, & Benzeval, 1998; Ecob & Davey Smith, 1999; Wolfson, Kaplan, Lynch, Ross, & Backlund, 1999), such that the average difference in health status between those near the bottom of the income ladder and those a few steps up is positive and more pronounced than it is among steps nearer the top.

Two ideal-typical explanations for this relationship can be proffered (Lynch, Due, Muntaner, & Davey Smith, 2000; Wilkinson, 2000). The 'materialist' explanation focuses on the absolute purchasing power of income, arguing that income secures material resources that subsequently influence health. The 'psychosocial' explanation, on the other hand, focuses on interpretation and perception. It argues that people generally feel better about themselves, and engage in more satisfying interactions with others, when they feel they 'do well' relative to their peers, i.e., when they have high social status. These perceptions are then presumed to influence peoples' mental and physical health. According to this interpretation, income mostly serves as an indicator of one's place in the status hierarchy rather than as a cause of health, but may, nonetheless, have an indirect influence on health through its effect on rank within status hierarchies. If material resources only go so far, and if comparisons with peers particularly (and negatively) affect the health of those lower in the status hierarchy, these two explanations may, separately or jointly, explain the diminishing returns for health from income. They may also contribute to understanding ecological relationships between community wealth and average levels of health.

Community wealth and population health

The degree of overall wealth in communities or societies may be a determinant of the health of some or all community or society members, *above and beyond* the effect of personal income on health for the residents of communities (Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996; Wilson & Daly, 1997; Lynch et al., 1998; Soobader & LeClere 1999; Lynch, Due, Muntaner, & Davey Smith, 2000; Veenstra, 2001). Community wealth might potentially influence overall levels of health by affecting *other* health-relevant attributes of communities, attributes such as the nature of government policies, the quality of health care, pollution and environmental hazards, criminal activity, the nature of the distribution of wealth, the efficiency of transportation systems, safety in workplaces, social capital or cohesion and structured social inequalities, for example. Although empirical evidence regarding relationships between community wealth and population health exists among Western nations and among communities such as the state, metropolitan area, county, census tract and neighbourhood within the United States, little evidence pertaining to the Canadian context has been reported to date.

A relationship between societal wealth and population health among the wealthiest nations of the world has not been demonstrated unequivocally. Relating GNP per head to life expectancy among 23 Western nations, Wilkinson (1992) reported a moderately strong correlation of $r = 0.38$. Using more current data and the same measures of wealth and health, Lynch et al. (2000) described a correlation of $r = 0.51$ among the 33 richest nations of the world, in contrast, however, with a *negative* correlation of $r = -0.11$ among the 21 richest nations and a positive correlation of only $r = 0.08$ among the 23 healthiest ones (Wilkinson, 2000). As such it is by no means clear that societal wealth corresponds with better health among the wealthier nations of the world.

Within the United States, on the other hand, the evidence for a relationship between community wealth and health is better established. Kaplan et al. (1996) produced a correlation of $r = -0.28$ between median income and total mortality rates among 50 American states, while Lynch et al. (1998) produced the same correlation between per capita income and age-adjusted total mortality among 282 metropolitan areas. Fiscella and Franks (1997) reported a correlation of $r = -0.41$ between a measure of survival and mean income among 105 counties or combined county areas. Even stronger correlations between median household income and life expectancy, $r = 0.73$ for males and $r = 0.59$ for females, were reported among 77 neighbourhoods in Chicago (Wilson & Daly, 1997). Taken together, these findings suggest that community wealth may have a stronger relationship with population health at lower levels of geopolitical aggregation than it does at higher levels.

Discerning an effect for community wealth above and beyond the effect of personal income on health requires multilevel analysis. In one comparison of American census tracts and counties, median family income was found to be more applicable for the self-rated health status of white males aged 25–64 among (the smaller) census tracts than among counties (log odds of 2.36 versus 1.66 for those in the lowest income category, respectively), after controlling for socio-demographic attributes of respondents that included personal incomes (Soobader & LeClere 1999). In a comparison of American counties and (the somewhat larger) metropolitan areas, Blakely, Lochner and Kawachi (2002) report a stronger effect for average household income on self-rated health status among 216 counties than among 232 metropolitan areas (log odds of 1.24 versus 1.18 for those in the lowest income quartile, respectively), after controlling for income inequality at the ecological level and for various socio-demographic attributes of respondents, including household income. Similar analysis at the state-level produced a log odds value of 1.21 for the

lowest average household income quintile (Blakely et al., 2002). These findings point to (an at least modest) effect for the overall wealth of the community on peoples' health above and beyond the material or psychosocial explanations for personal income on health at the individual level, and suggest again that such an effect operates more strongly at lower levels of aggregation than at higher ones, at least within the context of the United States.

Results pertaining to community wealth and health at similar levels of geopolitical aggregation are not available for Canada, although ecological analysis at the level of health district in the Canadian province of Saskatchewan failed to produce any meaningful relationships between both average and median household incomes and age-standardized mortality rates among 30 health districts (Veenstra, 2002a). Given that income and health appear to be related among individuals in Canada, are community wealth and population health related in that country as well, and, if so, at which geopolitical level of community? The following ideal-typical scenarios serve to orient this exploration of ecological relationships between community wealth and mortality rates among coastal communities in the province of British Columbia, Canada.

	Significant relationship	*No relationship*
Ecological	Explanatory ecological correlates	Confounding ecological correlates
Individual-level	Materialist and/or psychosocial interpretation	Psychosocial interpretation

First, a relationship between community wealth and health may be positive and truly ecological in nature, at least in part, such that community wealth reflects or contributes to other characteristics of communities that are health-inducing. Conversely, a significant ecological relationship may simply reflect one between income and health among individuals (the statistical artefact explanation), such that wealthier places have wealthier people, on average, each of whom (i) is better able to secure those material resources that sustain and promote good health and/or (ii) compares favourably in social status with all members of all communities. Should community wealth be found unrelated to mortality, on the other hand, the psychosocial explanation is still viable if people mainly compare themselves with peers from their *own* communities, making differences in absolute levels of wealth *among* communities irrelevant. Conversely, a positive ecological relationship may be masked by the presence of negative confounding factors, e.g. economic concentration in a wealth-producing but dangerous industry.

Coastal communities in British Columbia, Canada

The analysis conducted in this article will point to the viability of these ideal-typical scenarios in the context of 24 coastal communities in British Columbia, setting the stage for a survey of community residents, conducted in the summer of 2002, that will eventually facilitate multilevel analysis and further narrow the possibilities. The investigation of a possible relationship between community wealth and mortality constitutes the confirmatory part of this analysis, driven by the hypothesis that community wealth is indeed relevant for the health of these community residents.

To better understand a relationship between community wealth and population health, if one emerges, in exploratory fashion this article will also consider other economic attributes of communities that may be antecedent to a community wealth–health relationship or make a relationship between them spurious in nature. First, wealthier places presumably have less poverty, on average. Poorer places may be less healthy on average mostly because of the ill health effects of poverty on that sub-population. Second, presumably wealthier places receive more in the way of incomes from employment than from welfare sources or government transfers in general. If receipt of income from the state correlates with ill health at the individual level, then at the ecological level the receipt of incomes from such sources may also inform a wealth–health relationship, in fact making it a statistical artefact. In an ecological sense, on the other hand, greater poverty and/or care-taking by the state may be related to other ecological characteristics of communities, i.e. criminal activity or social class dynamics, that influence health. Finally, some economic industries are clearly more wealth-producing than others. If certain industries are more dangerous for the health of workers and also pay workers poorly, or if concentration in certain industries is a indicator of social class dynamics, dynamics that produce profits for some but also a social milieu detrimental to the health of some or all of the population, then a community wealth–health relationship may be informed by inclusion of such antecedent variables in multivariate analysis. (Income inequality, the degree to which income is distributed in an uneven fashion among the members of a community, has received significant attention in recent years as an ecological determinant of health. Two measures of income inequality, the proportion of total income dollars held by poorest 50% of households and the proportion held by the poorest 10% of households, were unrelated to age-standardized and gender-specific mortality rates among these same coastal communities (Veenstra, 2002b).)

The 24 communities analysed in this article are the incorporated municipalities along the Pacific coast of British Columbia, Canada, excluding the large urban

centres of Vancouver and Victoria. They represent the communities of the 'Toward a Healthy British Columbia' project, funded by the Canadian Institutes of Health Research, a project that seeks to understand the social and economic determinants of health in a non-urban, purportedly resource industry setting. The dominant industries in these communities for 1996, the most recent year for which economic data are available, were not intensively resource-based as they had been in the past, i.e. concentrations in mining, forestry, agriculture and fishing were actually quite low in 1996. Instead, the retail and manufacturing industries were best represented in these communities. The boxes demarcating geographical locations in Fig. 1 are sized by age-adjusted all-cause mortality. The spatial patterning suggests that mortality rates are not dispersed randomly, i.e. that some regional level (versus community level) effect may be operative, as the mortality rates in the highest category (the largest boxes represent mortality rates more than two standard deviations above the mean) are more prevalent in the southeast.

These coastal communities are an interesting setting in which to explore ecological, social and economic determinants of health. Many of the communities are quite geographically isolated from others and so *should* be communities in the true sense of the word: i.e. they should share a common identity, a sense of 'we-ness' (and a municipal government, health and social services, recreation facilities, etc.). Most also have small populations, many little larger than the neighbourhoods explored in Chicago by Wilson and Daly (1997), giving additional reason to hypothesize that community wealth, potentially more operative at lower levels of geopolitical aggregation, is a determinant of health in this context. This investigation, albeit limited to the ecological level analytically, is important for several reasons. First, it will help to establish whether community wealth as a determinant of health is a meaningful notion in the Canadian context. Canada is a nation that, unlike the United States, provides state-sponsored health care services to all citizens, and, through taxation, seeks to mitigate the profound differentials in incomes that exist to the south. It is not obvious that differences in collective wealth by place should be relevant for health in this nation. Second, if community wealth is indeed related to population heath in this context, these results will aid in undermining the individualistic orientation taken by many health researchers and health

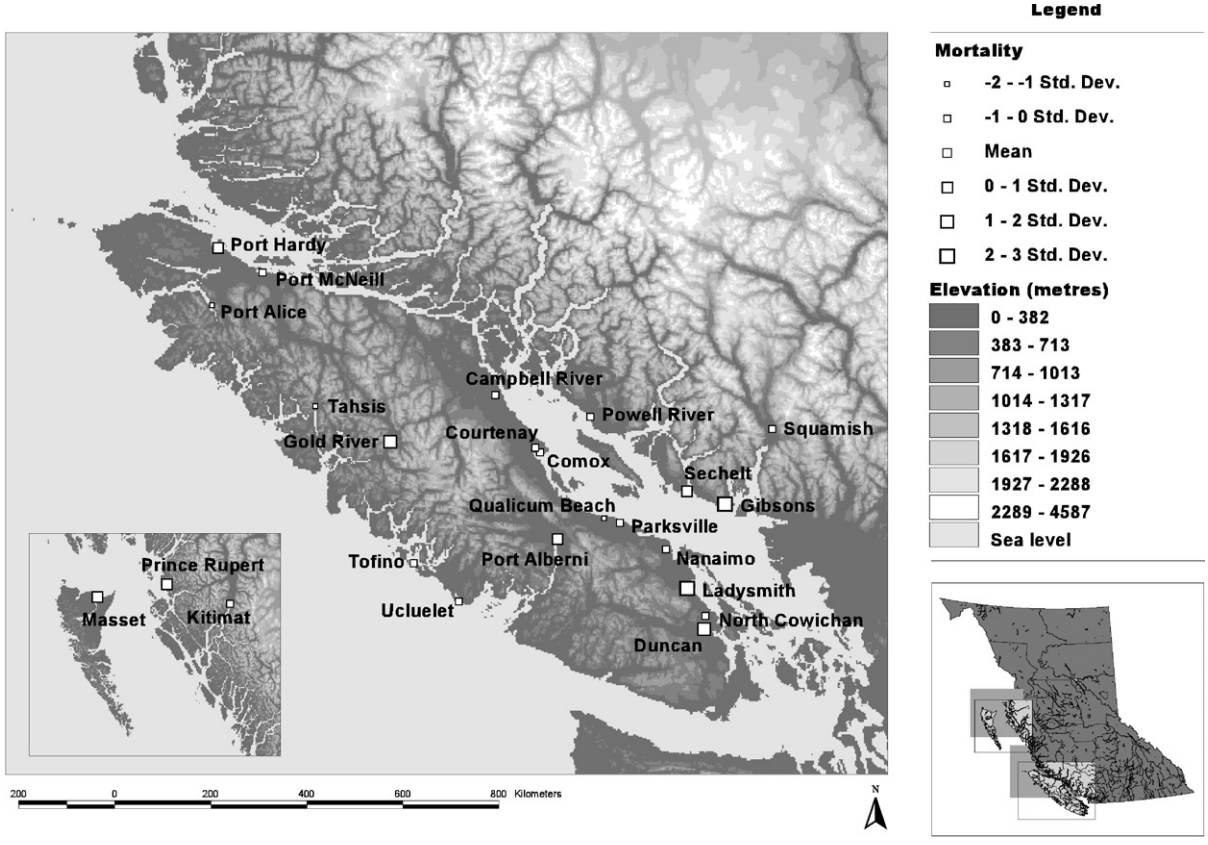

Fig. 1. Coastal communities in British Columbia.

policy makers in Canada, stimulating at least consideration of potentially health-relevant social structural characteristics of *places* and *communities*. The results presented here will also add to the growing body of literature highlighting compelling relationships between economic and health inequalities more generally, a discourse that has captured the attention of many health researchers around the world.

Methods

The population health measures were assembled by Vital Statistics of the British Columbia Ministry of Health and comprise the crude mortality rate, the mortality rate standardized for age and the age-standardized mortality rates (overall and within three age groups) for males and for females. Because of small population sizes, to preserve confidentiality and to provide stable estimates, the mortality rates provided by Vital Statistics were averaged over a 5-year time period (1994–1998) (Table 1).

The economic data was drawn from the 1996 Census of the population and was assembled by BC Statistics of the provincial government. As in most studies at sub-national levels, community wealth was measured by average and median household income. This is somewhat problematic, as income data does not include all monetary assets and thus may underestimate the total wealth of households. On the other hand, some households may have negative net worth, not reflected by income data, in which case such data may sometimes overestimate the total wealth of households. Several other economic attributes of communities were also measured. A measure for poverty in a community utilized the percentage of households below the low income threshold defined by Statistics Canada while the percentage of households who spend more than 30% of their incomes on shelter costs provided a measure of disposable income. The proportion of the population aged 0–64 who received welfare assistance (i.e. BC Benefits), the proportion of income dollars in the community derived from government transfer payments and the employment rate for those aged 15–64 speak to the sources of incomes in these communities. With respect to the nature of economic industry, the Census provides a five-part breakdown of the industries, identifying the proportion of persons employed in

Table 1
Coastal communities in British Columbia

	Community	Population, 1996	Average household income, 1996	Age-standardized mortality rate, 1994–1998
Northern mainland and Queen Charlotte Islands	Masset	1293	50,105	96.07
	Prince Rupert	16,714	54,760	81.07
	Kitimat	11,136	62,944	73.45
Vancouver Island	Tahsis	940	61,341	54.71
	Port McNeil	2925	63,547	62.45
	Port Alice	1331	65,444	42.47
	Port Hardy	5283	55,708	80.06
	Gold River	2041	67,114	106.78
	Ucluelet	1658	52,374	64.73
	Tofino	1170	49,681	76.54
	North Cowichan	25,305	47,830	57.05
	Duncan	4583	32,374	117.56
	Ladysmith	6456	44,853	127.90
	Nanaimo	70,130	44,660	67.70
	Parksville	9472	37,749	75.41
	Qualicum Beach	6728	47,801	52.03
	Port Alberni	18,468	42,742	85.53
	Comox	11,069	50,572	74.81
	Courtenay	17,335	39,749	71.88
Southern mainland	Campbell River	28,851	50,834	74.21
	Powell River	13,131	46,128	71.45
	Gibsons	3732	41,620	127.76
	Sechelt	7343	44,870	81.45
	Squamish	13,994	56,012	61.56

blue-collar (i.e. manufacturing, construction and transportation), resource (i.e. fishing, logging, agriculture and mining), service (i.e. retail, realty, accommodation and other services), public (i.e. government, education and health) and white-collar (i.e. communications, wholesale trading, finance and business) industries.

In bivariate analysis, when the relationship was linear Pearson's r provided the measure of association, but when the assumption of linearity was violated, Kendall's *tau_b*, a non-parametric measure of association that also ranges from -1 to 1 but is slightly less powerful, was used instead. The non-parametric measure was always included with the parametric measure to facilitate comparisons. Partial correlations were used for multivariate analysis.

Results

Many of the economic attributes of communities were significantly and strongly related to the crude mortality rate (Table 2). These relationships were considerably weaker upon standardizing mortality for age, in most cases to the point of losing statistical significance, suggesting that relationships between these economic attributes of communities and crude mortality rates were in part spurious. Even so, average household income was still rather strongly related to age-standardized mortality (median income less so and not significantly), suggesting that community wealth may be a viable determinant of population health in this context. The incidence of low incomes was also related to age-standardized mortality, suggesting that rates of poverty may be relevant as well. Given the strong relationship between the incidence of low incomes and mean income ($r = -0.824$, $p<0.001$; $\tau = -0.611$, $p<0.001$) it is impossible to distinguish their effects on mortality from one another: not surprising the partial correlations between these variables and age-standardized mortality after controlling for the other were not significant. Distinguishing age-standardized mortality rates for males and females (which were significantly related to one another, $r = 0.526$, $p = 0.008$; $\tau = 0.319$, $p = 0.029$) led to stronger relationships for mean and median incomes and the incidence of low incomes with female mortality than with male mortality. Again, controlling for mean income eliminated most of the relationship between the incidence of low incomes and mortality, and vice versa, for both male and female mortality. Finally, although the receipt of incomes from welfare sources (i.e. the proportion receiving BC Benefits) was more strongly related to male than female mortality, for the most part the nature of the sources of incomes, i.e. the proportion of income dollars drawn from the state via transfers, was less pertinent for these rates of mortality than was mean household income itself.

These economic attributes of communities were variably related to the mortality rates for males and females of differing ages (Table 3). Although these attributes were more strongly related to female than male mortality overall, as just described, within specific age groups they showed themselves more pertinent to male than female mortality. All but the employment rate were significantly related to mortality rates for younger and middle-aged men, but none of these economic attributes of communities was significantly related to mortality rates for elderly men. Conversely, mortality rates for women within specific age categories were not

Table 2
Economic correlates of mortality rates

	Crude mortality rate 1994–1998 ($N = 24$)	Age-standardized mortality rate 1994–1998 ($N = 24$)	Age-standardized mortality rate for males 1994–1998 ($N = 24$)	Age-standardized mortality rate for females 1994–1998 ($N = 24$)
Average household income	$r = -0.784$, $p<0.001$	$r = -0.398$, $p = 0.054$	$r = -0.436$, $p = 0.033$	$r = -0.519$, $p = 0.009$
	$\tau = -0.696$, $p<0.001$	$\tau = -0.290$, $p = 0.047$	$\tau = -0.261$, $p = 0.074$	$\tau = -0.348$, $p = 0.017$
Median household income	$r = -0.787$, $p<0.001$	$r = -0.334$, $p = 0.111$	—	$r = -0.490$, $p = 0.015$
	$\tau = -0.717$, $p<0.001$	$\tau = -0.239$, $p = 0.102$	$\tau = -0.210$, $p = 0.150$	$\tau = -0.297$, $p = 0.042$
% low income households	$r = 0.701$, $p<0.001$	$r = 0.430$, $p = 0.036$	—	$r = 0.544$, $p = 0.006$
	$\tau = 0.465$, $p = 0.001$	$\tau = 0.305$, $p = 0.037$	$\tau = 0.327$, $p = 0.025$	$\tau = 0.393$, $p = 0.007$
% shelter costs exceed 30%	$r = 0.754$, $p<0.001$	—	—	$r = 0.496$, $p = 0.014$
	$\tau = 0.543$, $p<0.001$	$\tau = 0.196$, $p = 0.180$	$\tau = 0.167$, $p = 0.254$	$\tau = 0.283$, $p = 0.053$
% dollars from transfers	$r = 0.809$, $p<0.001$	—	—	$r = 0.384$, $p = 0.064$
	$\tau = 0.664$, $p<0.001$	$\tau = 0.229$, $p = 0.118$	$\tau = 0.229$, $p = 0.118$	$\tau = 0.258$, $p = 0.078$
% dependent on BC Benefits	$r = 0.661$, $p<0.001$	—	—	—
	$\tau = 0.478$, $p = 0.001$	$\tau = 0.203$, $p = 0.165$	$\tau = 0.304$, $p = 0.037$	$\tau = -0.232$, $p = 0.112$
Employment rate	$r = -0.334$, $p = 0.110$	$r = -0.152$, $p = 0.478$	$r = -0.240$, $p = 0.259$	$r = -0.118$, $p = 0.583$
	$\tau = -0.239$, $p = 0.102$	$\tau = -0.065$, $p = 0.655$	$\tau = -0.239$, $p = 0.102$	$\tau = -0.022$, $p = 0.882$

Table 3
Economic correlates of age-standardized mortality rates in three age groups, 1994–1998

Males

	Aged 0–44 ($N = 24$)	Aged 45–64 ($N = 24$)	Aged 65 and over ($N = 24$)
Average household income	$r = -0.641$, $p = 0.001$	$r = -0.539$, $p = 0.007$	$r = -0.216$, $p = 0.311$
	$\tau = -0.464$, $p = 0.001$	$\tau = -0.399$, $p = 0.006$	$\tau = -0.167$, $p = 0.254$
Median household income	$r = -0.593$, $p = 0.002$	$r = -0.499$, $p = 0.013$	$r = -0.172$, $p = 0.423$
	$\tau = -0.413$, $p = 0.005$	$\tau = -0.348$, $p = 0.017$	$\tau = -0.159$, $p = 0.275$
% low income households	$r = 0.567$, $p = 0.004$	$r = 0.623$, $p = 0.001$	—
	$\tau = 0.407$, $p = 0.005$	$\tau = 0.495$, $p = 0.001$	$\tau = 0.145$, $p = 0.321$
% shelter costs exceed 30%	$r = 0.649$, $p = 0.001$	$r = 0.575$, $p = 0.003$	—
	$\tau = 0.428$, $p = 0.003$	$\tau = 0.377$, $p = 0.010$	$\tau = 0.072$, $p = 0.620$
% dollars from transfers	$r = 0.541$, $p = 0.006$	$r = 0.427$, $p = 0.037$	—
	$\tau = 0.388$, $p = 0.008$	$\tau = 0.279$, $p = 0.056$	$\tau = 0.229$, $p = 0.118$
% dependent on BC Benefits	$r = 0.443$, $p = 0.030$	$r = 0.439$, $p = 0.032$	$r = 0.266$, $p = 0.209$
	$\tau = 0.319$, $p = 0.029$	$\tau = 0.326$, $p = 0.026$	$\tau = 0.254$, $p = 0.083$
Employment rate	—	—	—
	$\tau = -0.254$, $p = 0.083$	$\tau = -0.275$, $p = 0.059$	$\tau = -0.188$, $p = 0.197$

Females

	Aged 0–44 ($N = 24$)	Aged 45–64 ($N = 24$)	Aged 65 and over ($N = 23$)[a]
Average household income	—	$r = -0.370$, $p = 0.075$	$r = -0.395$, $p = 0.062$
	$\tau = -0.246$, $p = 0.092$	$\tau = -0.246$, $p = 0.092$	$\tau = -0.289$, $p = 0.054$
Median household income	—	$r = -0.342$, $p = 0.102$	$r = -0.361$, $p = 0.091$
	$\tau = -0.239$, $p = 0.102$	$\tau = -0.196$, $p = 0.180$	$\tau = -0.233$, $p = 0.119$
% low income households	—	$r = 0.410$, $p = 0.047$	$r = 0.529$, $p = 0.009$
	$\tau = 0.204$, $p = 0.165$	$\tau = 0.247$, $p = 0.091$	$\tau = 0.353$, $p = 0.019$
% shelter costs exceed 30%	—	—	—
	$\tau = 0.196$, $p = 0.180$	$\tau = 0.123$, $p = 0.399$	$\tau = 0.075$, $p = 0.616$
% dollars from transfers	—	$r = 0.238$, $p = 0.263$	$r = 0.324$, $p = 0.131$
	$\tau = 0.171$, $p = 0.244$	$\tau = 0.156$, $p = 0.286$	$\tau = 0.238$, $p = 0.113$
% dependent on BC Benefits	—	—	—
	$\tau = 0.014$, $p = 0.921$	$\tau = 0.188$, $p = 0.197$	$\tau = 0.257$, $p = 0.086$
Employment rate	—	—	$r = 0.025$, $p = 0.911$
	$\tau = -0.051$, $p = 0.728$	$\tau = -0.123$, $p = 0.399$	$\tau = 0.062$, $p = 0.937$

[a] Mortality rates were not available for Tahsis.

at all well explained by these attributes, where only two interesting relationships surfaced, i.e. both elderly and middle-aged women appeared to fare more poorly in communities with a higher incidence of low incomes, elderly women more so. In short, a focus upon mortality rates for men and women within specific age categories produced compelling support for the community wealth–health hypothesis for men of working age and younger *only*, whereas the incidence of low incomes, a measure of poverty in communities, was shown most pertinent to mortality rates among elderly *women*.

Economic industry concentrations may serve to elucidate some of the preceding relationships, in that some industries may be wealthier than others and have a healthier population, thereby making such industry concentrations antecedent to the wealth–health connection. In exploratory fashion, the proportion of the working populace employed in each of the five broad industry categories was matched to every age-standardized mortality rate. A few significant relationships emerged. For females, age-standardized mortality was significantly and negatively related to concentration in blue-collar industries ($r = -0.542$, $p = 0.006$; $\tau = -0.261$, $p = 0.074$) and positively related to white-collar work ($r = 0.540$, $p = 0.006$; $\tau = 0.312$, $p = 0.033$). Elaborating further within age categories, white-collar concentration was positively related to mortality for elderly women in particular ($r = 0.532$, $p = 0.009$; $\tau = 0.344$, $p = 0.022$). For men, concentration in service and blue-collar industries was *positively* related to mortality for young males ($r = 0.464$, $p = 0.023$; $\tau = 0.362$, $p = 0.013$; $\tau = 0.399$, $p = 0.006$, respectively). Thus, a relatively heavy concentration in blue-collar industries, i.e. manufacturing, construction and transportation, was

related to lower rates of mortality for all women and to higher rates for young men. A relatively heavy concentration in the poorer white-collar industries, i.e. communications, whole-sale trading, finance and business, had the opposite effect on mortality rates for elderly women, and a concentration in service industries, i.e. retail, realty, accommodation and other services, appeared particularly relevant for mortality rates among young males.

To clarify, among these communities, a concentration in blue-collar industries was not strongly correlated with higher mean incomes ($\tau = 0.217$, $p = 0.137$), but service industry concentration ($r = -0.741$, $p < 0.001$; $\tau = -0.580$, $p < 0.001$) and concentration in the white-collar industries ($r = -0.573$, $p = 0.003$; $\tau = -0.297$, $p = 0.042$) had strong and negative relationships with mean income. Focusing only on the mortality rates for which industry concentration variables were especially pertinent, i.e. males 0–44, females 65 and older and all females, partial correlations between mortality for young males and concentration in service industries upon controlling for other economic attributes of communities such as mean household income and the incidence of low incomes were all non-significant, as was the partial correlation between female mortality among those 65 and older and white-collar concentration upon controlling for the incidence of low incomes. However, all-age female mortality retained some interesting relationships with white-collar concentrations after controlling for these other economic attributes. After controlling for the average household income, median household income, incidence of low incomes and shelter costs variables, respectively, the partial correlations between female mortality and white-collar concentration were $r = 0.346$ ($p = 0.106$), $r = 0.363$ ($p = 0.089$), $r = 0.366$ ($p = 0.086$) and $r = 0.385$ ($p = 0.070$). In short, service industry concentration was probably antecedent to a wealth–health connection for young males, as was white-collar concentration on the relationship between the incidence of low incomes and mortality for elderly women. A higher concentration in white-collar industries was (not quite significantly) related to higher mortality rates for females after controlling for these economic attributes of communities, however, suggesting that the nature of economic industry regarding white-collar work may hold relevance for such female rates above and beyond an influence on household incomes and thence health.

Discussion

In summary, average household income (a simple measure of community wealth) was negatively related to age-standardized mortality, median income less so, providing some support for the community wealth–health hypothesis. The incidence of low incomes, a measure of poverty, was even more strongly related to age-standardized mortality than was community wealth. Broken down by gender, these measures of community wealth and poverty were more strongly related to overall female mortality than to male mortality. Broken down by gender *and* age, most of the economic attributes of these communities, i.e. mean and median income, the incidence of low incomes, a lack of disposable income and incomes derived from government sources, were significantly related to mortality rates for younger and middle-aged men but not for elderly men. Conversely, among elderly women only, mortality rates were higher in communities with a lower average household income and a higher incidence of low incomes. A concentration in blue-collar, white-collar and service industries helped to explain relationships between the wealth and poverty variables and some mortality rates by (probably) serving as antecedent variables that determine household incomes. Finally, a higher concentration in white-collar industries was almost significantly related to higher mortality rates for females after controlling for other economic attributes of communities, and concentration in blue-collar industries was related to higher rates of mortality for young men, suggesting that the health of women and young men may be influenced by such industry concentrations through means other than the (lack of) wealth such economic activity brings to communities and households.

The positive findings pertaining to community wealth and health allow us to provisionally discharge two of the four scenarios delineated in the introduction, leaving the two options that seek to explain a positive relationship between community wealth and health. Are these empirical ecological relationships truly ecological in nature, in which case we should seek other explanatory ecological correlates, or do they simply reflect a relationship between income and health at the individual level, in which case we should particularly consider the materialist and psychosocial explanations? In the absence of individual-level data nested within these communities that facilitates multilevel analysis, in this instance we can only speculate about the viability of such competing interpretations and possible causal pathways.

Assuming the relationship between individual income and health is ubiquitous, given the materialist argument we would predict that any given population of wealthier people at any level of analysis would be healthier than any poorer population, on average, at least to the degree that material resources are similarly available and priced. (The latter assumption is potentially problematic, however, due to the geographical isolation of some communities.) As such the results presented here provide some indirect support for the argument that the

true causal pathways lie at the individual level and operate via materialist means. Upon adopting the psychosocial explanation, on the other hand, we would not expect ecological relationships between community wealth and population health to hold equally at all levels of analysis. Income relative to others is what matters in this instance, and if the entire strata of peers are represented in each community then the absolute degree of wealth of a community, in comparison with the other communities at least, is irrelevant. The ecological relationship *would* hold, on the other hand, if the communities are sub-sets of an encompassing community with whose members people generally compare themselves. It seems sensible to assume that Canadians rate their own status in comparison with an encompassing provincial or national community rather than exclusively with in-community peers, especially given national and global communications and media, although this is only an hypothesis. The psychosocial explanation, interpreted in this way, represents a second interpretation for the moderate relationships between community wealth and certain mortality rates described among these coastal communities, an interpretation that puts the true causal pathways at the individual level operating via psychosocial means. (Note that the same arguments apply to the relationships between the incidence of poverty and mortality.)

It is *possible* that a relationship between community wealth and health is the most pertinent causal pathway, wherein wealth influences overall levels of health via other ecological correlates that are themselves health-producing, and such that individual-level relationships between income and health produced from surveys that draw from members of all communities are statistical artefacts. People generally organize themselves into or identify with multiple 'communities' at any given point of time, i.e. neighbourhoods, cities, ethnic enclaves, religious communities, etc., only some of which will manifest themselves empirically in wealth and health relationships at the level of some specifically defined geopolitical 'community'. These coastal communities are as well-delimited as we could hope, at least in a geographical/political sense, giving good reason to consider ecological correlates of community wealth that may be health-inducing, although measures for concepts such as the levels of crime, social inequality, social capital or social cohesion, the availability of health services, etc., are not yet available for this setting. The search for such correlates should take specific consideration of the fact that the community wealth measures in this instance were particularly relevant for the health of younger and middle-aged males and elderly females.

The industry concentration and mortality relationships may particularly inform ecologically oriented explanations for variability in age-standardized female mortality rates and mortality rates for young men among these communities. With respect to the other mortality rates, industry concentration is most properly viewed as antecedent to the wealth–health relationship rather than as intervening, and so only elucidate the character of wealth–health relationships by pointing out that certain industries are better able to produce wealth than are others. With respect to the relationships between concentration in white-collar industries and female mortality, and blue-collar industries and mortality among young men, however, relationships that seem to hold beyond consideration of wealth accumulation, additional investigation is required.

This wealth of empirical findings, competing interpretations and varied speculations sets the stage for an in depth exploration of the social and economic determinants of the health of these populations, pursued in 2002 via a survey of individuals in these communities and the collection of community level data pertaining to social and cultural capital, social and economic inequality, social class dynamics and further empirical insight into the nature of economic activity. To understand the ecological relationships presented here we need to understand how the lived experience of peoples' everyday lives are embedded in the social, political and economic structures of communities in a way that goes far beyond what has been presented here, paying special attention to the lived experiences of men and women and of people at different stages of the life-course. If economic activity is itself in large part embedded in social relations (e.g. Granovetter, 1985; Woolcock, 2000, 2001), then the ultimate causes for interwoven inequalities in economy and health may properly reside in the interplay among social classes, races or ethnic groups and genders played out at home, work and in the civil space, an interplay that *sometimes* manifests itself as a community-level phenomena. This subject matter represents some of the most compelling yet poorly understood issues in public health research.

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References

Adler, N., Boyce, T., Chesney, M., Cohen, S., Folkman, S., Kahn, R., & Syme, S. (1994). Socioeconomic status and health: The challenge of the gradient. *American Psychologist*, *49*, 15–24.

Backlund, E., Sorlie, P. D., & Johnson, N. J. (1996). The shape of the relationship between income and mortality in the United States: Evidence from the national longitudinal mortality study. *Annals of Epidemiology*, *6*, 12–20.

Blakely, T. A., Lochner, K., & Kawachi, I. (2002). Metropolitan area income inequality and self-rated health—a multilevel study. *Social Science & Medicine*, *54*, 65–77.

Charlton, B. G., & White, M. (1995). Living on the margin: A salugenic model for socio-economic differentials in health. *Public Health*, *109*, 143–235.

Denton, M., & Walters, V. (1999). Gender differences in structural and behavioral determinants of health: An analysis of the social production of health. *Social Science & Medicine*, *48*, 1221–1235.

Ecob, R., & Davey Smith, G. (1999). Income and health: What is the nature of the relationship? *Social Science & Medicine*, *48*, 693–705.

Fein, O. (1995). The influence of social class on health status: American and British research on health inequalities. *Journal of General Internal Medicine*, *10*, 577–586.

Feinstein, J. S. (1993). The relationship between socioeconomic status and health: A review of the literature. *Milbank Quarterly*, *71*, 279–322.

Fiscella, K., & Franks, P. (1997). Poverty or income inequality as a predictor of mortality: Longitudinal cohort study. *British Medical Journal*, *314*, 1724–1728.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*, 481–510.

Humphries, K. H., & van Doorslaer, E. (2000). Income-related health inequality in Canada. *Social Science & Medicine*, *50*, 663–671.

James, W. P., Nelson, M., Ralph, A., & Leather, S. (1997). Socioeconomic determinants of health. The contribution of nutrition to inequalities in health. *British Medical Journal*, *314*, 1545–1549.

Judge, K., Mulligan, J., & Benzeval, M. (1998). Income inequality and population health. *Social Science & Medicine*, *46*, 567–579.

Kaplan, G. A., Pamuk, E., Lynch, J. W., Cohen, R. D., & Balfour, J. L. (1996). Income inequality and mortality in the United States. *British Medical Journal*, *312*, 999–1003.

Lynch, J., Due, P., Muntaner, C., & Davey Smith, G. (2000). Social capital—is it a good investment strategy for public health? *Journal of Epidemiology and Community Health*, *54*, 404–408.

Lynch, J. W., Kaplan, G. A., Pamuk, E. R., Cohen, R. D., Heck, K. E., Balfour, J. L., & Yen, I. H. (1998). Income inequality and mortality in metropolitan areas of the United States. *American Journal of Public Health*, *88*, 1074–1079.

Macintyre, S. (1997). The Black Report and beyond: What are the issues? *Social Science & Medicine*, *44*, 723–745.

Rogot, E., Sorlie, P. D., & Johnson, N. J. (1992). Life expectancy by employment status, income, and education in the national longitudinal mortality study. *Public Health Report*, *107*, 457–461.

Soobader, M. J., & LeClere, F. B. (1999). Aggregation and the measurement of income inequality: Effects on morbidity. *Social Science & Medicine*, *48*, 733–744.

Veenstra, G. (2000). Social capital, SES and health: An individual-level analysis. *Social Science & Medicine*, *50*, 619–629.

Veenstra, G. (2001). Social capital and health. *isuma*. *Canadian Journal of Policy Research*, *2*, 72–81.

Veenstra, G. (2002a). Social capital and health (plus wealth, income inequality and regional health governance). *Social Science & Medicine*, *54*, 849–858.

Veenstra, G. (2002b). Income inequality and mortality: coastal communities in British Columbia. *Canadian Journal of Public Health*, forthcoming.

Wilkinson, R. G. (1992). Income distribution and life expectancy. *British Medical Journal*, *304*, 165–168.

Wilkinson, R. G. (2000). Inequality and the social environment: A reply to Lynch et al. *Journal of Epidemiology and Community Health*, *54*, 411–413.

Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighbourhoods. *British Medical Journal*, *314*, 1271–1275.

Wolfson, M., Kaplan, G., Lynch, J., Ross, N., & Backlund, E. (1999). The relationship between income inequality and mortality: An empirical demonstration. *British Medical Journal*, *319*, 953–957.

Wolfson, M., Rowe, G., Gentleman, J. F., & Tomiak, M. (1993). Career earnings and death: A longitudinal analysis of older Canadian men. *Journal of Gerontological Social Science*, *48*, 167–179.

Wood, E., Sallar, A. M., Schecter, M. T., & Hogg, R. S. (1999). Social inequalities in male mortality amenable to medical intervention in British Columbia. *Social Science & Medicine*, *48*, 1751–1758.

Woolcock, M. (2000). Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theory and Society*, *27*, 151–208.

Woolcock, M. (2001). The place of social capital in understanding social and economic outcomes. *isuma*. *Canadian Journal of Policy Research*, *2*, 11–17.