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The inconsistency of risks among cities for each of the pollutants examined separately is similar to that of other studies examining multiple locales.^{2,3,7} One would expect more variation in the association of the more reactive and/or spatially heterogeneous pollutants such as carbon monoxide, sulphur dioxide, and nitrogen dioxide, with mortality compared to particulate mass since outdoor monitoring data are a poorer surrogate for personal exposure to the former versus latter pollutants.⁸ Furthermore, there are different circumstances in each city potentially leading to differing relationships between the monitoring site data and the population exposures. These differences point out that given the present study it is premature to dwell on differences in risks among cities. Instead we should take note of the fact that positive associations were found under a wide variety of circumstances, as represented by different Canadian cities, and that there was reasonable consistency among cities in the combined effect of the pollutant mixture.

We included the example on the sulphur reductions in gasoline to illustrate the importance of consideration of the pollution mixture on health when assessing the benefits of pollution reduction strategies and not to rely on the impact of a single pollutant measure such as particulate matter. In a recent review of the health bene-

fits of reductions in sulphur in gasoline, an expert panel⁹ was faced with using data from a US study on the association between mortality and fine particulate matter or sulphates, even though several air pollutants were predicted to decrease if sulphur levels in gasoline were reduced.

We attempted to improve on the current state of knowledge by examining Canadian data in multiple locations and including all the available information on pollution concentrations. The example was intended to demonstrate the importance of considering the health effects of urban pollution mixtures. We did not suggest that Canadian air pollution policy be independently developed based on this single study.

We are pleased that this paper has initiated an informed debate on this important public health issue and reiterate that further research may shed some light on these difficult scientific issues.

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Value of ecological analysis

Dear Editor:

Re: Elliott SJ, Dean A. An ecologic analysis of psychosocial stress and heart disease in British Columbia. *Can J Public Health* 1998;89(2):137-41.

The paper by Elliott and Dean¹ is a welcome addition to the literature. It highlights the role of the ecological approach in the understanding of disease etiology in
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researchers interested in issues of importance to public health, health care policy, and health care system management, its utility with respect to understanding the determinants of population health will also be enhanced, as other databases are 'linked in'.

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both human populations and individuals. As noted by the authors, among others,^{2,6} studies including ecological or group-level variables are necessary to examine the causal link between social environments, human behaviour, and disease development.

It was therefore surprising to read the conclusions of this paper, which seem to indicate that the ecological approach has limited utility in understanding disease etiology. Elliott and Dean write: "The difficulties of studying health issues...indicate that caution must be exercised when interpreting these results. Most important, this is ultimately an ecological level analysis. In order to link heart disease and psychosocial stress, the ideal dataset would contain measures of heart disease outcomes and indicators of stress, all preferably measured at *the individual level* [emphasis added], allowing conclusions to be made about *individual level* [emphasis added] relationships."¹ (p. 140) Presumably the basis for this view is the "ecological fallacy", "a logical fallacy inherent in making causal inferences from group data to individual behaviours."² (p.819) In the epidemiologic literature this fallacy has discredited the ecological approach, with ecologic or group-level studies being

viewed as crude attempts to determine individual-level associations.^{2,6}

Ecologic studies, however, are not simply substitutes for individual-level correlational studies.^{2,6} Very often a variable measured at the group level reflects a different construct or phenomenon than the same variable measured at the individual level. To illustrate, Schwartz writes: "The construct referenced on the ecological level may be the context or social environment in which individuals live, distinct from the attributes of those individuals. Thus, poverty as an individual characteristic and poverty as a neighbourhood characteristic may exert different, independent effects on health."² (p. 820) By viewing ecological studies as mere substitutes of individual-level studies, the potential independent effects (or causal influences) of the broader social environment (e.g., families, peer groups, communities, and legislation) are ignored or neglected. The utility of the ecologic approach is that it provides a unique opportunity to ascertain the social or group contexts which contribute to disease risk.

In the case of heart disease (and most other illnesses), it is likely that a multi-level analysis including both individual-level variables (e.g., physiologic risk factors) and

ecologic-level variables (e.g., job characteristics) will lead to a better understanding of etiology, in particular the mechanisms by which environmental stressors influence perceptions of stress and disease risk in individuals. Multi-level analysis will also indicate whether interventions to reduce risk should focus on the individual level, or the ecological level, or some combination of both.

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