ABSTRACT

Cardiovascular disease is the leading cause of death in Canada. However, much heart disease incidence cannot be explained by known risk factors, and evidence points to the potential role played by the psychosocial environment. This study involves an ecologic analysis exploring the relationships between psychosocial stress and ischaemic heart disease (IHD) in British Columbia. First, data from the Canada Health Promotion Survey correlated stress indicators (i.e., education, marital status) with self-reported stress levels. Results showed gender differences in stress. Stage II consisted of a multivariate analysis of ischaemic heart disease mortality in B.C. Results indicate a strong association between heart disease outcomes and educational background for both males and females. Findings of this study support a link between IHD and psychosocial factors. The results of the multiple regression must be interpreted with caution, given the use of an ecologic analysis. Additional research at the individual level is needed to fully understand these relationships.

ABRÉGÉ

Les maladies cardiovasculaires sont la cause principale des décès au Canada. Toutefois, les facteurs de risque connus ne peuvent expliquer en grande partie l'incidence des cardiopathies et certains cas semblent indiquer que l'environnement psychosocial pourrait aussi jouer un rôle. Cette étude comporte une analyse d'environnement qui explore les liens existant entre le stress psychosocial et la cardiopathie ischémique en Colombie-Britannique. Elle débute par des données d'indicateur de stress de l'Enquête Promotion Santé Canada (par ex., éducation, état matrimonial) mises en corrélation avec les degrés de stress déclarés par l'intéressé(e). Les résultats montrent qu'il existe des différences entre les sexes en matière de stress. L'étape II porte sur une analyse à plusieurs variables de la mortalité par cardiopathie en C.-B. Les résultats indiquent qu'il existe un lien solide entre l'évolution des cardiopathies et le niveau d'étude, qu'il s'agisse d'hommes ou de femmes. Les résultats issus des recherches de cette étude viennent appuyer l'existence d'un lien entre la cardiopathie ischémique et les facteurs psychosociaux. Le recours à une analyse d'environnement nous oblige à interpréter les résultats de la régression multiple avec prudence. Il est nécessaire de poursuivre les recherches au niveau de l'individu afin de comprendre pleinement ces relations.

An Ecologic Analysis of Psychosocial Stress and Heart Disease in British Columbia

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Cardiovascular disease is the leading cause of death in Canada and British Columbia (B.C.), and a substantial cause of disability and illness for Canadians.¹ While mortality rates for heart disease and stroke have shown steady declines since the 1960s, the burden of illness cardiovascular disease represents in terms of costs to the health care system as well as to the individual and quality of life remains high.² Further, it is now widely recognized that women experience the same levels of risk as men, particularly in terms of ischaemic heart disease.² That is, while women experience a certain level of risk protection prior to menopause, they experience similar, if not greater, levels of risk thereafter.¹

While conventional physiologic risk factors (smoking, nutrition, physical activity) serve to explain much of the etiology with respect to coronary heart disease, there is a substantial proportion of residual attributable risk left unexplained.³ A nascent body of evidence around psychosocial influences on coronary heart disease development is now beginning to make its mark,³⁻⁶ and while little etiologic evidence exists in the clinical literature regarding the relationship between psychosocial stress and coronary heart disease,⁷ it remains a central issue in both the popular⁸⁻¹⁰ and policy² realms. Indeed, the recent *Catalonia Declaration*,¹¹ the result of the 2nd International Heart Health Conference, declared "...the pervasive psychosocial stress of accelerated social

and economic change" as a factor contributing, along with physiologic risk factors, to the development of coronary heart disease. For these researchers, the natural question arises as to the potential health impacts of the stresses each of these additional roles may pose; i.e., the so-called "multiple burden hypothesis."¹²⁻¹⁴ More generally, the potential relationship between psychosocial stress and heart disease has been examined using stress indicator variables such as occupation,^{12,15} family and marital status^{5,12,14} as well as education and socioeconomic status.^{5,8,12,16}

The need to examine these questions for specific population groups is reflected in the choice of the B.C. population for this study, which to date has seen little work devoted to linking particular biophysical and sociocultural environments to heart disease incidence. To address these gaps, this research had two primary aims: 1) to determine what individual sociodemographic characteristics (i.e., income, occupation) could be linked to individual perceptions of psychosocial stress; and 2) to construct models of heart disease outcomes from psychosocial stress as identified by these stress indicators. Within these models, the existence and strength of relationships could be assessed, and the role of the multiple burden hypothesis for both men and women explored.

METHODS

The analysis for the study proceeded in two stages. At stage 1, 1990 Canada Health Promotion Survey data (CHPS) for B.C. were used to determine individual level stress indicators. The entire B.C. sample of 1,223, sufficient to ensure statistical validity,¹⁷ was used in stage 1. To compen-

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sate for the effects of the multi-stage, stratified, clustered sampling design of the CHPS, a 'design effect' adjustment was performed. The 'design effect' is a conservative figure intended to account for a portion of the stratification and clustering contained in the sample design, which is not considered in the variance calculations of standard statistical techniques.¹⁷ For this particular survey, a design factor of 1.5 was used to adjust the results, indicating that this particular survey is a little better than one-half as efficient as a perfect simple random sample.¹⁸

For the CHPS data, the chi-square test was used to examine the strength of relationships between self-reported stress and a string of sociodemographic variables (age, sex, education, occupation, marital and family status, ethnicity (i.e., language spoken) and income) documented in the literature as plausibly related to heart disease outcomes.^{6,9,14,15,19} Age was included in the analysis due to its association with life cycle stage, and consequent changing life roles and responsibilities.¹⁰ In addition, three stress indices were created by aggregating several individual items. A social support index was created by aggregating five individual items related to care and support of or by relatives and friends. A job stress index was created by aggregating five individual items related to unreasonable deadlines at work, unclear duties, lack of control and feedback and conflicts with co-workers. Finally, a physiologic risk factor index was created by aggregating items related to body mass index, cholesterol and blood pressure levels, smoking, physical activity, and alcohol consumption.

Variables and indices shown at stage 1 to be significantly related to self-reported stress were subsequently entered into a multiple regression exercise at stage 2, using mortality and morbidity from ischaemic heart disease (IHD) across three time periods (1985-1987; 1988-1990; 1991) as outcome variables. The source of these data was the B.C. Statistics Data Set, which provides ecological level data for the 79 Local Health Areas (LHAs) of B.C. These models were generated to determine if any of the individual stress indicators were related to ischaemic heart disease outcomes. Table I lists the variables that were

TABLE I
Variables Used in the Stage II Analysis
B.C. Statistics Dataset

Variables	Females	Males	Combined
Education	X	X	X
Less than grade 9			
High school non-graduate			
High school graduate			
Trades certificate or diploma			
Other non-university education			
University without degree			
University with degree			
Marital Status	X	X	X
Married			
Nonmarried (single, divorced, widowed, separated)			
Family Status - Total Families & Live Alone	X	X	X
Lone Parents	X	X	X
Labour Force - Employed & Unemployed	X	X	X
Occupation			X
Group 1 - managerial/professional			
Group 2 - clerical, sales and service			
Group 3 - farming, fishing, forestry			
Group 4 - processing, machining			
Group 5 - other			
Migration Status			X
Born in B.C.			
Born out of province			
Immigrant			
Ethnicity - English & Non-English speaking	X	X	
Immigration Status	X	X	
Non-movers			
Migrants from outside Canada			
Income	X	X	X
Religious Affiliation - Catholic, Protestant, Other			X

An "X" indicates that the variable was available, in the B.C. Statistics dataset, for use in a particular model.

TABLE II
Significant Associations Between Individual Sociodemographic Variables and
Self-Reported Stress - CHPS (1990) Dataset

Variable	Chi-Square	P Value
Combined (Males and Females)		
Education	20.5	<0.001
Language spoken	11.2	<0.001
Occupation	36.3	<0.001
Age	42.4	<0.001
Males		
Education	20.0	<0.001
Occupation	30.8	<0.001
Age	20.7	<0.01
Family status	13.2	<0.01
Income	18.5	<0.01
Language spoken	5.4	<0.05
Females		
Language spoken	4.4	<0.05
Age	28.0	<0.001

available for use in the stage 2 regression analysis for each of the male, female, and combined models. Note that age was not included in this analysis, due to the difficulty of isolating the psychosocial effects of age from those induced by normal physiologic "wear and tear". The stress indices from stage I (social supports, job stress, and physiologic risk factors) were not included due to the absence of these vari-

ables measured at the ecologic level in the stage 2 dataset.

RESULTS

An interesting pattern of relationships emerged in the context of self-reported stress as measured by the CHPS (Table II). First, there is a striking difference between males and females in the number and type

TABLE III
Multiple Regression Model Results for Female IHD - Mortality

Independent Variables	τ	p
1985-1987 Outcome Year		
R-squared = 0.59857 (Prob. F =0.000)		
High school non-graduate	2.48	0.016
University - No degree	3.71	0.000
Less than Grade 9	3.51	0.001
Other non-university education	4.98	0.000
Employed women with children	-3.70	0.000
Constant	-1.38	0.171
1988-1990 Outcome Year		
R-squared = 0.72811 (Prob. F =0.000)		
High school non-graduate	3.15	0.002
University - no degree	6.17	0.000
Less than Grade 9	4.45	0.000
Other non-university education	6.54	0.000
Employed women with children	-3.20	0.000
Constant	-2.86	0.006
1991 Outcome Year		
R-squared = 0.38740 (Prob. F =0.000)		
Other non-university education	4.61	0.000
Employed women with children	-4.69	0.000
Constant	2.08	0.041

TABLE IV
Multiple Regression Model Results for Male IHD - Mortality

Independent Variables	τ	p
1985-1987 Outcome Year		
R-squared = 0.61565 (Prob. F =0.000)		
Less than Grade 9	4.97	0.000
High school non-graduate	5.65	0.000
High school graduate	2.01	0.049
University - No degree	3.38	0.001
University degree	3.19	0.002
Other non-university education	5.29	0.000
Unemployed	-2.71	0.009
Employed	-6.41	0.000
Constant	-2.35	0.021
1988-1990 Outcome Year		
R-squared = 0.47225 (Prob. F = 0.000)		
Live alone	4.18	0.000
Income	2.48	0.016
Unemployed	-4.35	0.000
Employed	-6.81	0.000
Other non-university education	3.43	0.001
Constant	6.13	0.000
1991 Outcome Year		
R-squared = 0.58119 (Prob. F = 0.000)		
Live alone	2.07	0.042
Unemployed	-2.70	0.009
Employed	-8.09	0.000
Migrants - outside Canada	2.29	0.025
High school non-graduate	2.10	0.039
Trades certificate/Diploma	3.98	0.000
University - No degree	2.86	0.006
Constant	3.48	0.001

of individual stress indicators which were found to be significant. Only two variables were significant for females: age and language spoken (surrogate for ethnicity). In contrast, these plus several others related to socioeconomic and family status (education, occupation, income, family status - indicates either living alone or in a family household) were significant variables for men. Second, age and language spoken were augmented by education and occupa-

tion when males and females were combined. Thus, the realm of variables found significant related to both socioeconomic and family status, as well as individual variables. However, none of the aggregated indices (job, social support, physiologic risk factors) were found to be significantly related to self-reported stress.

Tables III, IV and V present a summary of the variables that appeared in the final models, for each of males, females and

combined (total population per LHA). The dependent variable was mortality from IHD. The models yielded intriguing results, given that the most important explanatory factor was education, and in particular, the type of educational categories that were most frequent in the models. Certain variables, specifically those that measured a failure to complete a particular educational level, "university without degree", "high school non-graduate", "less than grade 9 education", and "other non-university education", were the most significant recurring variables in the models. The direction of relationships was also significant. All educational variables were positively related to heart disease outcomes, with the exception of "university degree", which was negative in all cases except one. In addition, other important relationships included employment status, multiple roles (available for females only), and immigration status.

DISCUSSION

The types of stresses resulting from the multiple burden hypothesis are puzzling, since the literature points to a protective effect generated by the adoption of multiple roles for both females and males,^{14,20,21} although the public perception has been that adding roles increases stress. As well, self-reporting of stress levels has revealed that employed women rate themselves as more stressed, and yet employment is associated with better health in women.^{9,14} The results of the present research would seem to support this conclusion in the B.C. population, given that variables measuring female employment were negatively related to heart disease outcomes, as was the dual measurement variable, which combined the roles of working and having children at home. Overall, there does not seem to be much evidence in support of the multiple burden hypothesis for women. However, male stress appears to come from a variety of life roles and experiences, including job, family, ethnic background, and socioeconomic status (resulting from education and income). These findings seem to support the theory of excessive stress associated with multiple roles to a greater extent for males than females, given that stress from a

TABLE V
Combined Multiple Regression Model Results - IHD Mortality

Independent Variables	τ	p
1985-1987 Outcome Year		
R-squared = 0.59725 (Prob. F = 0.000)		
Less than Grade 9	8.01	0.000
High school non-graduate	3.29	0.002
Married	1.82	0.074
University - No degree	6.30	0.000
Other non-university education	4.61	0.000
Constant	-7.81	0.000
1988-1990 Outcome Year		
R-squared = 0.75949 (Prob. F = 0.000)		
Less than Grade 9	7.36	0.000
High school non-graduate	5.23	0.000
Married	2.59	0.012
University - No degree	8.63	0.000
Occupation 2 - Sales, service	-3.28	0.002
Occupation 3 - Resource jobs	-2.34	0.022
Other non-university education	5.83	0.000
Constant	-8.72	0.000
1991 Outcome Year		
R-squared = 0.64545 (Prob. F = 0.000)		
Less than Grade 9	5.78	0.000
High school non-graduate	4.35	0.000
Married	2.03	0.046
University - No degree	7.13	0.000
No religion	-3.54	0.001
Trades certificate/ Diploma	2.19	0.032
Other non-university education	2.83	0.006
Constant	-7.90	0.000

variety of life areas is reported to a greater degree by men.

The connections between psychosocial stress and disease are complex, difficult to understand and measure, and likely differ by individual.¹⁵ It may be that certain types of stress are experienced physiologically by the individual in different ways,¹³ and that stress in some circumstances may actually be beneficial. Since stress has such a negative connotation, when, and to whom, might it be beneficial? For the working wife and mother, perhaps the stress associated with multiple roles leaves her no time to worry about her health. As well, the additional opportunities for life satisfaction provided by the multiple roles of employee, spouse, and parent may compensate for harmful impacts on health.²¹ Finally, it is likely that only healthier individuals are able to maintain their position in the workforce, and thus may have some advantage in dealing with the negative effects of prolonged stress.^{19,21} It is possible that other types of stress, associated with low educational levels or low incomes, could lead to negative health consequences for the individual, in terms of life satisfaction and health status, as an outcome of both substantive factors (i.e., reduced ability to afford a healthy diet) and psychosocial

ones (i.e., failure to achieve life goals and resulting depression). The key element in whether stress is ultimately beneficial or harmful appears to be the manner in which the individual perceives it.

Little difference was noted between the multiple regression models for males and females with respect to the types of independent variables that surfaced in the final models (Tables III, IV, V). All models were dominated by educationally related variables, and nearly all measured a failure to complete specific educational levels. It appears that heart disease outcomes are similar in males and females with respect to the specific type of lifestyle adopted by this risk group (i.e., drop-outs) and/or the particular personality type associated with this educational status. The implications of this result could be quite significant. Level of education is important, in terms of being able to take care of oneself, make use of health care resources, and practice preventive health behaviours, but it may be that a particular attitude or outlook on life is also playing a meaningful role. Seeing situations or events in either a positive or negative light would definitely affect how one is able to cope with and respond to specific stressors. Inability to carry through on completing one's educational ambitions

and goals may indeed reflect a lack of self-esteem or motivation, a feeling of failure, or simply anger at the world or one's place in it. In future research, a changed focus to better reflect these types of attitudes might be gained through a reinterpretation of the Type A personality construct, and this modified perspective may help to provide new insight into how the psychosocial aspects of life affect health outcomes.

The difficulties of studying health issues of such a personal nature 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, allowing conclusions to be made about individual level relationships. Unfortunately, a dataset that contains all of the required elements does not exist for B.C., primarily due to issues of confidentiality.

Despite methodological obstacles, the results of this research have offered some useful insights into the nature of the links between psychosocial factors and heart disease, and overall, the results appear to support the conclusion that although certain life experiences, individual characteristics, and particular roles may be "stressful", they are not necessarily harmful to health in terms of heart disease mortality. In fact, it may be quite the opposite, since many studies, including this one, have found that multiple roles are associated with better health, as are such "stressful" life roles as employment. This study has reinforced these conclusions for heart disease specifically, revealed intriguing links between heart disease, education and related life attitudes, and ultimately provided some sense of where to proceed in terms of unravelling these complex interrelationships.

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COMING EVENTS ACTIVITÉS À VENIR

To be assured of publication in the next issue, announcements should be received by May 15, 1998 and valid as of June 30, 1998.

Announcements received after May 15, 1998 will be inserted as time and space permit.

Pour être publiés dans le prochain numéro, les avis doivent parvenir à la rédaction avant le 15 mai 1998 et être valables à compter du 30 juin 1998. Les avis reçus après le 15 mai 1998 seront insérés si le temps et l'espace le permettent.

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For more details, see page 108 of this issue/Pour plus
de détails, voir à la page 108 de ce numéro

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