

# Regional Socio-economic Context and Health

- *It's who you are and what you do, not where you live, that has a greater influence on the state of your health.*
- *Self-reporting of fair or poor health was strongly associated with individuals' age, sex, socio-economic position (as measured by education and household income), smoking, obesity, and infrequent exercise.*
- *Regional socio-economic context was modestly associated with self-reported fair or poor health.*

## **Abstract**

### **Objectives**

To determine the influence of health region socio-economic context on the self-rated health of Canadians.

### **Data sources**

Individual data are from the first cycle of the 2000/01 Canadian Community Health Survey. Health region-level social, demographic, and economic characteristics were derived from the 1996 Census (short and long forms), the Canadian Vital Statistics Database, and the Demography and Geography Divisions of Statistics Canada.

### **Analytical techniques**

Multilevel logistic regression was used to model fair or poor health.

### **Main results**

At the individual level, the perception of fair or poor health was strongly associated with age, sex, socio-economic position (as measured by education and household income), smoking, obesity, and infrequent exercise. Overall, a handful of individual factors accounted for much of the variation between health regions in reporting of fair or poor health. There was an additional influence of socio-economic context on individual reporting of fair or poor health at the health region scale, but it was modest.

### **Conclusion**

This Canadian study has not demonstrated as strong an influence of the social environment on individual health status as have studies in the United States and the United Kingdom. Federal and provincial government programs such as universal health care, unemployment insurance and old age security is one possible hypothesis that may explain the main results of the study.

### **Key words**

Health status; self-perceived health; socio-economic context; multilevel studies; health risk factors.

### **Authors**

Stéphane Tremblay (613-951-4765; stephane.tremblay@statcan.ca) is a senior analyst with the Health Analysis and Measurement Group, Nancy A. Ross (613-398-4307; nancy.ross@mcgill.ca) is an Assistant Professor in the Department of Geography at McGill University and an Associate of the Health Analysis and Measurement Group, and Jean-Marie Berthelot (613-951-3760; jean-marie.berthelot@statcan.ca) is the manager of the Health Analysis and Measurement Group, all at Statistics Canada, Ottawa, Ontario, K1A 0T6.

Stéphane Tremblay, Nancy A. Ross and Jean-Marie Berthelot

This analysis considers the influence of the regional social environment on the self-rated health of Canadians. Social environment can be defined in many ways: physical surroundings, cultural milieu, social groups, institutions, and public policy.<sup>1,2</sup> (Note: *Social environment, or social context, is defined here by the socio-economic and demographic profile of a health region using Census data*). Individual risk factors such as age, family income, and smoking are known to influence individual health, but the social environment may also have an effect, over and above individual factors. If so, public policy could address the social conditions of places as a way of improving overall population health.<sup>3</sup>

## Methods

### Data sources

Data for the present analysis came from the first cycle (cycle 1.1) of the 2000/01 Canadian Community Health Survey (CCHS). Social, demographic, and economic determinants of health for each health region (see Appendix Table B) were derived from four Statistics Canada data sources: the 1996 Census (short and long forms), the Canadian Vital Statistics Database, and the Demography and Geography Divisions of Statistics Canada. Of the 118,336 CCHS respondents aged 18 or older from 136 health regions, 53 were excluded from the analytical sample because they did not report their perceived health. Dummy variables were created for each explanatory variable that had missing information, to keep as many respondents in the analysis as possible and to control for potential bias introduced by non-response.

Appendix Table A lists the resulting 136 health regions, and the number of respondents from each (296 to 2,495), the 1996 population (18,000 to 2.5 million).

### Analytical techniques

Multilevel model software (MlwiN)<sup>4</sup> was used to fit logistic models of fair or poor health, a binary health outcome. The logit function was used to model the relationship between health outcome and various explanatory variables. MlwiN does not calculate the deviance of the models (representing the lack of fit between the model and the data) for binary outcomes. Therefore, inferences on model specifications could not be generated. Standardized weights were used at the individual level, and equal weights were used at the health region level, since the CCHS does not sample at the latter level.

Three models were developed incrementally. This process allowed simultaneous consideration of *i* individuals nested within *j* health regions. The first model, usually called the "empty" or "null" model, was fitted with no explanatory variables. The empty model was used to determine whether overall differences between health regions in terms of the percentage of people reporting fair or poor health were significant.

The second model, called the "individual" model, included various individual characteristics, to allow assessment of the association between fair or poor health and these characteristics. This model was also used to determine if there were still significant differences between health regions after individual-level characteristics were taken into account. In addition to the age and sex of each individual, this second model fitted socio-demographic characteristics, such as income and education, and common health risk factors, such as smoking, obesity, and physical activity (see *Definitions* in Appendix Table B). For each individual-level characteristic, binary variables (0,1) were derived for the non-reference group categories.

Since the differences between health regions were still significant after controlling for individual characteristics, a third model, called the "final" model, was generated, which included all explanatory variables at the individual plus four health region variables. With this model, it was possible to begin exploring the extent to which the social environment of the health region plays a significant role in the reporting of fair or poor health for different health risk factors.

Four synthetic independent and standardized, i.e. average 0 and standard deviation 1, factors were derived at the health region level from the total of 21 variables, which were primarily demographic and socio-economic census variables potentially related to the variations in reporting of fair or poor health. These factors were constructed through principal component analysis, a standard statistical method used to reduce the number of variables to analyse. These four synthetic factors—"Remote," "Prosperous," "Cosmopolitan," and "Disadvantaged"—each represented a separate subset of the original variables; this methodology was also employed by Mayer et al.<sup>5</sup> (see *Definitions* in Appendix Table B).

All estimates resulting from the multilevel modeling are tested with a Chi-square test with a significance level of  $p < 5\%$ .

### Limitations

Most of the research in this area involves a theoretical understanding of health as a function of individual and social environmental characteristics. When individuals interact with their environment, at some point the social environment must "get under the skin" and affect their health<sup>6</sup>; however, the subtleties of this interaction are beyond the scope of this analysis. Until the theoretical understanding of exactly how environments influence health along some causal pathway is more fully developed, it will be difficult to build models to examine these mechanisms.

Even with the availability of multilevel statistical models to address the relationships between social environment and health, the complexity of these relationships is not well understood. For instance, individual smoking behaviour can be influenced by the degree to which social contexts are more or less supportive of smoking, perhaps through the existence of restrictive bylaws. The degree to which cultures and norms shape individual behaviours should be the focus of future work related to the CCHS.

Because this work is cross-sectional, causal claims cannot be made about the relationship between the explanatory variables and individual health outcomes. In addition, other features of the social environment that might be related to health within health regions, for example, social connectedness or public health policies, were not measured.

The scale used for social context in this analysis, the health region, has both advantages and disadvantages. Although public health and health care policy are, to some degree, determined at this scale in some provinces, the towns and neighbourhoods within some health regions do not share all socio-spatial characteristics of the health region. Therefore, it is quite possible that the heterogeneity of the social environment within any given health region is greater than that between health regions. A study of the influences on health of differences in social environment between declining inner-city neighbourhoods in Canada's largest cities and the more affluent suburbs of the same cities might yield different results than those reported here. Determining the ideal geographic scale for conducting multilevel studies of health outcomes is the subject of current research.

A variety of evidence supports a connection between conditions in the social environment and health. For example, in the 19th century, Durkheim reported that suicide rates differed between places and that these differences remained remarkably constant through time, even though the make-up of the populations within the places changed.<sup>2,7</sup> In modern times, community disadvantage has consistently been associated with low school readiness and achievement and with behavioral and emotional problems in children.<sup>8,9</sup>

Evidence from studies in the United States and the United Kingdom suggests that both the characteristics of individuals and the characteristics of the social environments in which they live and work, can both affect health. A recent review reported that 23 of 25 studies (with a wide variety of study designs and geographic units of analysis) had shown at least a moderate relationship between the social environment and individual health status, over and above individual characteristics.<sup>10</sup> Although this evidence strongly suggests a connection between social environment and health outcomes, such a relationship has never been clearly demonstrated for Canada.

Three recent Canadian studies of the effects of social environment on health outcomes (in Ontario, Québec, and Nova Scotia) differed in both their approaches and their results. One study yielded modest evidence for an association of place with health outcomes; the effects varied by the type of outcome measured and the spatial definition of regions.<sup>11</sup> The second found significant variations in health status at the local level but not the regional level, after accounting for individual characteristics.<sup>12</sup> The third study found no association between social context and risk of death at the neighbourhood level.<sup>13</sup> In Canada, health outcome indicators including mortality, life expectancy, disability-free life expectancy, and self-perceived health status differ substantially at the regional level<sup>5,14</sup> (see also the previous study in this series, “The Health of Canada’s Communities” by Shields and Tremblay). However, the extent to which this regional variation is attributable to the composition of the population within each health region, rather than to the social context, remains an open question.

A more complex analysis of the relationships between health region social environments and the health of Canadians—after taking explicit account of individual characteristics—is required. A multilevel logistic regression analysis provides estimates of the probabilities of Canadians reporting fair or poor health as a function both of the socio-demographic characteristics of their health region, and their own socio-economic and health-related risk profiles. In

other words, this type of analysis describes simultaneously the associations of health regions’ social environment and individuals’ own circumstances with individual’s health status. It examines the effects of geographic region above and beyond the characteristics of individuals living in these regions (see *Methods and Limitations*).

### General health of individuals

In Table 1, according to the 2000/01 Canadian Community Health Survey (CCHS) data, 22.8% of the Canadian population aged 18 or older smoke daily, 14.3% are obese, 21.3% engage in physical activity less than four times a month, and 12.8% report being in fair or poor health (see *Definitions* in Appendix Table B). The proportion of people reporting fair or

Table 1  
Characteristics reported as percentage of total Canadians aged 18 or older

	Percentage
<b>Self-reported health</b>	
Fair/poor health	12.8
Excellent/very good/good	87.2
<b>Characteristics</b>	
<b>Age</b>	
18 to 29	21.2
30 to 44†	32.0
45 to 64	31.2
65 or older	15.6
<b>Sex</b>	
Female†	51.0
Male	49.0
<b>Education</b>	
Less than secondary	22.4
Secondary	20.2
Some post-secondary‡	8.7
Post-secondary	47.7
<b>Income group‡</b>	
Lowest	3.5
Lower-middle	6.8
Middle	19.8
Upper-middle†	32.0
Highest	27.7
<b>Smoking status</b>	
Don't smoke†	72.7
Smoke daily	22.8
Smoke occasionally	4.4
<b>Obesity‡</b>	
Obese	14.3
Non-obese†	83.0
<b>Physical activity</b>	
Infrequent exerciser	21.3
Frequent exerciser†	71.0

**Data source:** Canadian Community Health Survey, cycle 1.1, 2000/01

**Notes:** In this table, variables with missing information for some records are included in order to retain these individuals for analyses and to control for potential bias due to missing information.

† Category used to illustrate the reference group in the models.

‡ See *Definitions* in Appendix.

poor health by health region ranged from a low of 6.8% in Headwaters Regional Health Authority in Alberta to a high of 22.3% in Region 5 (Campbellton) in New Brunswick and in Parkland in Manitoba (see Appendix Table A).

### Who is in fair or poor health?

In general, individuals' reports of fair or poor health status were patterned by age, sex, education, and household income. Table 2 shows the proportions reporting fair or poor health according to a series of individual-level factors one at a time. Table 3 shows the relative odds of reporting fair or poor health for each individual-level factor adjusted for all of the other ones.

Table 2  
Proportion of fair or poor health among Canadians aged 18 or older

Characteristics	Proportion
	%
<b>Age</b>	
18 to 29	5.1
30 to 44†	7.3
45 to 64	15.1
65 or older	29.7
<b>Sex</b>	
Female†	13.5
Male	12.0
<b>Education</b>	
Less than secondary	25.8
Secondary	10.9
Some post-secondary†	9.3
Post-secondary	7.9
Missing	18.6
<b>Income group‡</b>	
Lowest	27.6
Lower-middle	26.6
Middle	18.3
Upper-middle†	10.2
Highest	5.7
Missing	15.2
<b>Smoking status</b>	
Don't smoke†	12.0
Smoke daily	15.8
Smoke occasionally	8.8
<b>Obesity‡</b>	
Obese	20.7
Non-obese†	11.4
Missing	13.0
<b>Physical activity</b>	
Infrequent exerciser	22.8
Frequent exerciser†	9.3
Missing	16.9

**Data source:** Canadian Community Health Survey, cycle 1.1, 2000/01  
**Notes:** In this table, variables with missing information for some records are included in order to retain these individuals for analyses and to control for potential bias due to missing information.  
 † Category used to illustrate the reference group in the models.  
 ‡ See Definitions in Appendix.

Older Canadians reported fair or poor health more often than younger Canadians, and there were notable increases in the reporting of fair or poor health in those over age 45. The odds of reporting fair or poor health for Canadians aged 45 to 64 were twice as likely, and those aged 65 or older nearly four times as likely, to report fair or poor health as the reference age group (aged 30 to 44).

While women reported fair or poor health more often than men, once the other factors (e.g. age) are taken into account, they are slightly less likely than men to report fair or poor health (Table 3). Lower education level and lower household income were associated

Table 3  
Adjusted odds ratios for fair or poor health by individual and health region characteristics compared to the reference category

Characteristics	Individual model		Final model	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
<b>Age</b>				
18 to 29	0.67	0.63, 0.72	0.67	0.63, 0.72
30 to 44†	1.00	...	1.00	...
45 to 64	2.16	2.05, 2.27	2.16	2.05, 2.27
65 or older	3.85	3.63, 4.07	3.84	3.63, 4.06
<b>Sex</b>				
Female†	1.00	...	1.00	...
Male	1.06	1.02, 1.10	1.06	1.02, 1.10
<b>Education</b>				
Less than secondary	1.44	1.34, 1.56	1.45	1.34, 1.57
Secondary	0.90	0.83, 0.98	0.90	0.83, 0.98
Some post-secondary†	1.00	...	1.00	...
Post-secondary	0.80	0.74, 0.87	0.80	0.74, 0.87
<b>Income group‡</b>				
Lowest	3.07	2.82, 3.34	3.07	2.83, 3.34
Lower-middle	2.38	2.23, 2.54	2.38	2.23, 2.54
Middle	1.53	1.45, 1.60	1.53	1.45, 1.61
Upper-middle†	1.00	...	1.00	...
Highest	0.65	0.61, 0.70	0.65	0.61, 0.69
<b>Smoking status</b>				
Don't smoke†	1.00	...	1.00	...
Smoke daily	1.53	1.46, 1.60	1.53	1.46, 1.60
Smoke occasionally	1.10*	0.99, 1.22	1.10*	0.99, 1.22
<b>Obesity</b>				
Obese	1.74	1.66, 1.82	1.74	1.67, 1.82
Non-obese†	1.00	...	1.00	...
<b>Physical activity</b>				
Infrequent exerciser	2.10	2.01, 2.19	2.10	2.02, 2.19
Frequent exerciser†	1.00	...	1.00	...
<b>Synthetic factor§</b>				
Remote			0.96*	0.92, 1.01
Prosperous			1.06	1.01, 1.10
Cosmopolitan			1.00*	0.96, 1.04
Disadvantaged			1.04*	1.00, 1.08

**Data source:** Canadian Community Health Survey, cycle 1.1, 2000/01  
 † Category used to illustrate the reference group in the models.  
 ‡ See Definitions in Appendix.  
 § Change in odds when the factor is increased by one standard deviation  
 \* Not significantly different from the reference category.  
 ... Not applicable

with greater odds of reporting fair or poor health. For both education and income, each step down the socio-economic ladder was associated with greater odds of reporting fair or poor health (except for those with secondary graduation in Table 3), and those in the lowest income category had an overwhelming five-fold greater risk of reporting fair or poor health than those in the top income category. As might be expected, reporting fair or poor health was greater among daily smokers, obese individuals, and infrequent exercisers than among others. Daily smokers were 1.5 times as likely as non-smokers to report fair or poor health. Individuals classified as obese also had significantly greater odds of reporting fair or poor health than non-obese individuals. Similarly, infrequent exercisers were twice as likely to report fair or poor health as more frequent exercisers. These results are consistent with previous Canadian studies.<sup>15,16</sup>

## Multilevel studies of health

Multilevel or contextual studies of health seek to account for individual health outcomes simultaneously affected by characteristics of individuals and the environment in which they live. Multilevel models were first employed in the field of education in an effort to determine the value that schools or classrooms were adding to student achievement, above and beyond the students' own characteristics. These models, also known as hierarchical or random effects models, have become increasingly popular in health research, coinciding with epidemiologists' renewed interest in social contexts.<sup>18</sup>

The statistical advantages of multilevel models over traditional statistical models are discussed in detail elsewhere.<sup>19,20</sup> Briefly, individuals living in the same health region share similar experiences such as culture, environment, health behaviours, health care services, and experiences. Therefore, people living within a particular health region tend to be more alike than those living in different health regions. The main objective of multilevel studies is to "partial out" observable similarities to better understand the effect of these common exposures. These similarities within regions cause analytical problems for traditional statistical analyses. Multilevel models are specifically designed to deal with "like" people in "like" places and to parse out effects at various levels of analysis.

## What is the influence of socio-economic context on health?

In order to explore further the role of the socio-economic context, a series of 21 demographic and socio-economic variables were derived for 136 health regions in Canada from the 1996 census and Statistics Canada's Geography Division (see *Definitions* in Appendix Table B). Since many of these variables are highly correlated, an analysis was undertaken to reduce these to a manageable number of synthetic social environment factors. This analysis resulted in four factors that could be summarized by the words: "Remote" - the degree of remoteness from large urban centers, "Prosperous" - the degree of economic prosperity, "Cosmopolitan" - the degree of urbanization and ethnic diversity, and "Disadvantaged" - the degree of social and economic disadvantage.

The odds, reported in the right hand part of Table 3, include both the individual-level variables and the four synthetic factors at the health region level. After the effects of population composition and individual health risk factors were accounted for, these four synthetic factors were generally not significant. There was a relatively small association for one of the social environment factors, "Prosperous". In this case, the odds ratio was 1.06 for each increase of one standard deviation from the mean. This small but significant finding runs counter to most epidemiological evidence linking greater economic prosperity and better health<sup>17</sup>, and deserves further investigation.

This modest association is best explained by the smaller differences among health regions remaining in the proportions reporting fair or poor health compared with the national average, after adjustment for individual characteristics (see *Methods*).

To put these results in context, recall that overall, the unadjusted range of health region proportions of individuals reporting fair or poor health is 15.5%. This is shown graphically in Map 1, and in the "Unadjusted" column in Appendix Table A.

On the map, red indicates health regions with a higher proportion of people reporting fair or poor health, and blue indicates health regions with a lower proportion. In addition, the darker the shade, the greater the deviation of the region's proportion reporting fair or poor health from the national average.

These "unadjusted" figures, however, are potentially misleading because elderly individuals, to take one individual-level characteristic, are more likely to describe themselves as being in fair or poor health, and some regions have older or younger populations than the national average. Adjusting for these

differences in the age composition of the regions results in the range narrowing slightly to 14.4%, as shown in Map 2 and the “Age standardized” column of Appendix Table A.

As a third step, the effects of other individual-level socio-demographic characteristics (beyond age) and health-related risk factors have been taken into account (left side of Table 3). This results in the range across Canada’s health regions decreasing by over one-third to 9.2%. Further adjustment by including the four synthetic social environment variables (i.e. moving from the “individual” to the “final” model in Table 3) did not noticeably affect this latter range.

The transition from Map 1 to Map 2 does not show much change, except in Nunavut and in Swift Current (Saskatchewan). This is in line with the observation above that age standardization reduced the range of proportions reporting fair or poor health only somewhat from 15.5% to 14.4%. However, comparing maps 2 and 3 shows a more substantial decrease in the variations among health regions. For example, the health regions with the largest declines in the proportion with fair or poor health are from the territories, the northern parts of the Prairies and to some extent the Atlantic provinces. The only region with a substantial increase was North Shore, B.C. It had the lowest age-adjusted rate of fair or poor health, but would have been close to the national average if its residents had the same income, education, and health risk factors as the rest of the country (Appendix Table A)

Essentially, these comparisons among the maps, which are spelled out in greater detail in Appendix Table A, suggest that a large portion of the observed inter-regional variations in self-reported health status can be attributed to variation in the mix of individuals living within each region in terms of their socio-economic characteristics (income and education) and health-related risk factors (smoking, obesity, and physical activity). Nevertheless, Map 3 and the last column of Appendix Table A still show variations.

Overall, these findings suggest that individual factors accounted for much of the variation among health regions in reporting fair or poor health. The influence of specific social environment factors, those listed in Appendix Table B, on individual reporting fair or poor health at the health region scale was small by comparison.

### Concluding remarks

These results suggest that self-reported fair or poor health is strongly associated with individual-level characteristics and is modestly associated with regional social context.

There are many possible hypotheses for this relatively small contribution of health regions’ social context on individual health status differences. There are number of federal and provincial government programs such as universal health care, unemployment insurance and old age security, designed to address social disparities, and they may well attenuate the effects of the regional social context. In addition, the particular geographic unit used in the analysis, the health region, may not be the most appropriate for representing individuals’ experiences of social context. For example, metropolitan health regions such as Toronto and Montréal have diverse social structures, so that for most people a smaller geographic unit like a “neighbourhood” would be more appropriate. Health region differences may also be due to regional variables other than social context as it was measured here. Social capital is a concept that refers to the overall quality of social relationship within a community. This concept is thought to play an important role in the explanation of variation in health status across geographic localities<sup>16,21</sup>.

Interestingly, further analysis (data not shown) has examined several health system characteristics, specifically the number of hospital beds, general practitioners, specialists and physicians per capita. None of these variables was statistically significant in a multilevel regression analysis. In other words, the variations between regions in the availability of these health care services do not appear to play a role in accounting for individual health status differences.

From an international perspective, Canadian studies have not demonstrated as strong an influence of the social environment on individual health status as have studies in the United States and the United Kingdom. This difference may indicate that Canada already has a range of social and health policies that have been relatively effective in preventing health inequalities, at least on a regional scale. Nevertheless, in line with many other studies, this analysis supports the fundamental importance of individual socio-economic circumstances and key health-related risk factors in accounting for variations in individuals’ health status. And even though health region effects were modest, many strategies that address these broader determinants of health may be most effectively developed at the health region level.<sup>22,23</sup>

## Acknowledgements

The authors would like to thank Maria Glieca for map production and Kathy White for editorial assistance.

## References

- 1 Barnett E, Casper M. A definition of "social environment" [letter]. *American Journal of Public Health* 2001; 91: 465.
- 2 Yen IH, Syme SL. The social environment and health: a discussion of the epidemiologic literature. *Annual Review of Public Health* 1999; 20: 287-308.
- 3 MacIntyre S, Maclver S, Sooman A. Area, class and health: Should we be focusing on places or people? *Journal of Social Policy* 1993; 22: 213-34.
- 4 Goldstein H, Rasbash J, Plewis I, et al. *A user's guide to MLwiN*. London, UK: Multi-level Models Project, Institute of Education, University of London, 1998.
- 5 Mayer F, Ross NA, Berthelot J-M, Wilkins R. Disability-free life expectancy by health region. *Health Reports* (Statistics Canada, Catalogue 82-003) 2002; 13(4): 49-60.
- 6 Taylor SE, Repetti RL. Health psychology: What is an unhealthy environment and how does it get under the skin? *Annual Review of Psychology* 1997; 48: 411-47.
- 7 Schwartz S, Diez-Roux R. Commentary: causes of incidence and causes of cases—a Durkheimian perspective on Rose. *International Journal of Epidemiology* 2001; 30: 435-9.
- 8 Leventhal T, Brooks-Gunn J. The neighbourhoods they live in: the effects of neighbourhood residence on child outcomes. *Psychological Bulletin* 2000; 126: 309-38.
- 9 Tremblay S, Ross NA, Berthelot J-M. Factors affecting grade three student performance in Ontario: a multi-level analysis. *Education Quarterly Review* 2001; 7: 25-36.
- 10 Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology and Community Health* 2001; 55: 111-22.
- 11 Boyle MH, Willms JD. Place effects for areas defined by administrative boundaries. *American Journal of Epidemiology* 1999; 149: 577-85.
- 12 Pampalon R, Duncan C, Subramanian SV, Jones K. Geographies of health perception in Quebec: a multilevel perspective. *Social Science and Medicine* 1999; 48: 1483-90.
- 13 Veugelers PJ, Yip AM, Kephart G. Proximate and contextual socioeconomic determinants of mortality: multilevel approaches in a setting with universal health care coverage. *American Journal of Epidemiology* 2001; 154: 725-32.
- 14 Statistics Canada. *Health indicators* (Statistics Canada, Catalogue 82-221-XIE) 2002. Available at <http://www.statcan.ca>. Accessed on May 8<sup>th</sup> 2002.
- 15 Shields M, Shoostari S. Determinants of self-perceived health. *Health Reports* (Statistics Canada, Catalogue 82-003) 2001; 13(1): 35-52.
- 16 Ross NA. Community belonging and health. *Health Reports* (Statistics Canada Catalogue 82-003) 2002; 13(3):33-9.
- 17 Evans R, Barer M, et al. *Why Are Some people Healthy and Others Not?* New York: Aldine deGruyter, 1994.
- 18 Diez-Roux A-V. Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *American Journal of Public Health* 1998; 88: 216-22.
- 19 Aitkin MA, Longford NT. Statistical modeling issues in school effectiveness studies. *Journal of the Royal Statistical Society A* 1986; 149: 1-43.
- 20 Goldstein H. *Multilevel statistical models*. London: Kendall's Library of Statistics 3, 1995.
- 21 Kawachi I. Social Capital and Community Effects on Population and Individual Health. In *Socioeconomic Status and Health in Industrial Nations: Social, Psychological, and Biological Pathways*. Adler NE, Marmot M, McEwen BS, Stewart J, Eds.: Annals of the New York Academy of Sciences Volume 896, New York, 1999.
- 22 Rose G. Sick individuals and sick populations. *International Journal of Epidemiology* 1985; 14: 32-8.
- 23 Starfield B. Basic concepts in population health and health care. *Journal of Epidemiology and Community Health* 2001; 55: 452-4.
- 24 Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *Journal of Health and Social Behavior* 1997; 38(1): 21-37.
- 25 Kaplan GA, Goldberg DE, Everson SA, et al. Perceived health status and morbidity and mortality: evidence from the Kuopio Ischaemic Heart Disease Risk Factor Study. *International Journal of Epidemiology* 1996; 25(2): 259-65.
- 26 Brazier JE, Harper R, Jones NMB, et al. Validating the SF-36 Health Survey Questionnaire: new outcome measure for primary care. *British Medical Journal* 1992; 305: 160-4.

## Appendix

Table A  
Proportion of fair or poor health among Canadians aged 18 or older

Health region		Size		Proportion reporting fair or or poor health		
		Sample	1996 population ('000)	Unadjusted (%)	Age standardized (%)	Adjusted for individual characteristics (%)
Code	Name					
1001	NF-Health and Community Services St John's Region	804	187	12.6	13.0	12.0
1002	NF-Health and Community Services Eastern Region	707	125	14.3	14.5	9.9
1003	NF-Health and Community Services Central Region	604	113	14.3	13.7	10.5
1004	NF-Health and Community Services Western Region	549	93	13.5	13.4	10.1
1005	NF-Grenfell Regional Health Services Board	296	18	13.5	13.9	10.6
1006	NF-Health Labrador Corporation	437	26	12.1	14.5	11.3
1101	PEI-Urban	1,294	63	13.6	13.5	13.1
1102	PEI-Rural	2,081	72	12.8	12.4	11.3
1201	NS-Zone 1 (Yarmouth/South Shore)	865	128	19.3	17.7	14.6
1202	NS-Zone 2 (Kentville)	657	83	15.6	14.7	14.1
1203	NS-Zone 3 (Truro)	701	106	17.4	16.6	14.3
1204	NS-Zone 4 (New Glasgow)	604	100	16.6	15.6	13.4
1205	NS-Zone 5 (Cape Breton)	728	143	17.8	16.2	13.1
1206	NS-Zone 6 (Halifax)	1,182	371	12.8	13.4	14.0
1301	NB-Region 1 (Moncton)	893	183	17.0	16.7	14.8
1302	NB-Region 2 (Saint John)	801	178	14.5	14.1	13.1
1303	NB-Region 3 (Fredericton)	798	165	16.2	16.2	13.4
1304	NB-Region 4 (Edmunston)	507	55	21.9	21.5	17.7
1305	NB-Region 5 (Campbellton)	436	33	22.3	21.6	16.1
1306	NB-Region 6 (Bathurst)	606	89	18.0	18.0	13.2
1307	NB-Region 7 (Miramichi)	438	50	20.1	19.5	15.1
2401	QC-Région du Bas-Saint-Laurent	1,025	209	13.8	13.1	10.1
2402	QC-Région du Saguenay - Lac-Saint-Jean	1,005	291	9.7	9.9	9.9
2403	QC-Région de Québec	1,552	645	9.5	9.2	8.9
2404	QC-Région de la Mauricie-Centre-du-Québec	1,488	484	12.2	11.6	10.5
2405	QC-Région de l'Estrie	1,054	283	12.1	11.7	10.1
2406	QC-Région de Montréal-Centre	2,495	1808	12.3	11.9	10.8
2407	QC-Région de l'Outaouais	1,061	313	15.8	16.3	14.1
2408	QC-Région de l'Abitibi-Témiscaminque	1,107	157	13.8	14.3	11.9
2409	QC-Région de la Côte-Nord	977	105	13.4	13.6	12.4
2410	QC-Région du Nord-du-Québec	611	19	8.4	11.1	11.3
2411	QC-Région de la Gaspésie-Îles-de-la-Madeleine	1081	107	15.3	14.4	11.0
2412	QC-Région de la Chaudière-Appalaches	1,289	387	11.0	10.9	9.7
2413	QC-Région de Laval	965	336	10.5	10.3	11.4
2414	QC-Région de Lanaudière	1,341	382	11.7	11.8	11.2
2415	QC-Région des Laurentides	1,282	441	9.5	9.5	10.0
2416	QC-Région de la Montérégie	2,216	1287	11.8	11.9	10.4
3526	ON-Algoma	731	130	19.3	18.2	15.5
3527	ON-Brant	689	123	12.5	12.4	13.2
3530	ON-Durham	1,236	473	11.9	12.6	15.5
3531	ON-Elgin-St Thomas	671	81	12.2	12.0	12.5
3533	ON-Bruce-Grey-Owen Sound	782	158	15.3	13.8	13.4
3534	ON-Haldimand-Norfolk	642	106	17.1	16.7	14.7
3535	ON-Haliburton	883	162	14.4	13.1	12.9
3536	ON-Halton	1,148	350	8.9	9.0	12.0
3537	ON-Hamilton-Wentworth	1,176	482	16.0	15.7	15.8
3538	ON-Hastings and Prince Edward	831	157	13.5	12.8	12.3
3539	ON-Huron	480	62	13.5	12.3	13.2
3540	ON-Kent-Chatham	951	113	12.4	12.0	11.7
3541	ON-Kingston	852	181	12.2	11.6	13.0
3542	ON-Lambton	773	133	15.7	15.3	14.5
3543	ON-Leeds	821	160	13.7	12.9	13.5



Health region		Size		Proportion reporting fair or or poor health		
		Sample	1996 population ('000)	Unadjusted (%)	Age standardized (%)	Adjusted for individual characteristics (%)
Code	Name					
3544	ON-Middlesex-London	1,149	404	10.9	11.1	12.2
3545	ON-Muskoka-Parry Sound	710	81	14.7	12.6	12.4
3546	ON-Niagara	1,149	415	13.4	12.4	13.4
3547	ON-North Bay	903	96	17.2	16.6	15.4
3549	ON-Northwestern	650	84	14.4	13.9	14.6
3551	ON-Ottawa Carleton	1,728	743	11.6	12.0	14.4
3552	ON-Oxford	638	100	10.1	9.8	11.9
3553	ON-Peel	1,655	882	10.3	11.5	13.8
3554	ON-Perth	654	74	12.0	11.6	12.3
3555	ON-Peterborough	801	127	14.1	12.6	14.2
3556	ON-Porcupine	696	100	19.5	19.7	16.7
3557	ON-Renfrew	650	101	18.0	17.1	15.2
3558	ON-Eastern Ontario	881	192	13.2	13.0	12.8
3560	ON-Simcoe	1183	340	13.8	13.4	14.3
3561	ON-Sudbury	889	208	17.8	17.4	16.0
3562	ON-Thunder Bay	859	167	16.0	15.8	15.9
3563	ON-Timiskaming	460	40	18.1	16.9	15.1
3565	ON-Waterloo	1,177	418	12.5	13.2	13.4
3566	ON-Wellington-Dufferin-Guelph	1,041	224	9.9	10.2	11.5
3568	ON-Windsor-Essex	1,128	361	16.2	16.5	16.4
3570	ON-York	1,509	612	10.5	11.2	13.4
3595	ON-City of Toronto	2,295	2463	13.4	13.4	14.9
4610	MB-Winnipeg	1,878	640	12.9	12.7	12.0
4615	MB-Brandon	612	47	14.0	13.6	13.0
4620	MB-North Eastman	458	38	14.3	13.0	14.4
4625	MB-South Eastman	669	52	12.1	12.8	12.0
4630	MB-Interlake	667	75	14.5	13.3	13.0
4640	MB-Central	743	95	11.8	11.2	11.2
4650	MB-Marquette	571	38	12.7	10.0	10.1
4655	MB-South Westman	487	35	12.0	10.7	9.7
4660	MB-Parkland	556	44	22.3	19.1	14.2
4670	MB-Norman	491	24	15.2	16.2	13.7
4680	MB-Burntwood+Churchill	434	46	9.8	16.3	12.1
4701	SK-Weyburn (A) Service Area	537	59	14.4	12.6	11.9
4702	SK-Moose Jaw (B) Service Area	678	59	12.5	11.2	11.6
4703	SK-Swift Current (C) Service Area	432	47	10.1	8.7	9.7
4704	SK-Regina (D) Service Area	1,039	246	13.4	13.1	12.7
4705	SK-Yorkton (E) Service Area	559	62	21.1	17.0	14.2
4706	SK-Saskatoon (F) Service Area	1,140	279	12.6	12.7	13.1
4707	SK-Rosetown (G) Service Area	445	48	12.4	11.7	10.6
4708	SK-Melfort (H) Service Area	691	44	15.6	13.5	10.8
4709	SK-Prince Albert (I) Service Area	585	76	15.4	14.1	11.6
4710	SK-North Battleford (J) Service Area	660	68	13.6	13.1	12.5
4711	SK-Northern Health Services Branch (K) Svc Area	379	32	13.1	16.3	13.2
4801	AB-Chinook Regional Health Authority	808	145	13.2	13.6	12.9
4802	AB-Palliser Regional Health Authority	652	87	10.5	10.3	10.8
4803	AB-Headwaters Regional Health Authority	618	71	6.8	7.5	9.5
4804	AB-Calgary Regional Health Authority	1,856	845	9.3	10.0	11.3
4805	AB-Regional Health Authority #5	558	53	10.3	10.2	12.0
4806	AB-David Thompson Regional Health Authority	856	181	12.5	13.2	13.9
4807	AB-East Central Regional Health Authority	701	104	12.7	12.0	11.2
4808	AB-Westview Regional Health Authority	562	89	11.7	12.7	13.2
4809	AB-Crossroads Regional Health Authority	537	39	13.9	14.4	12.2
4810	AB-Capital Health Authority	1,891	783	12.0	12.7	13.8
4811	AB-Aspen Regional Health Authority	692	88	14.6	14.8	12.8
4812	AB-Lakeland Regional Health Authority	708	108	12.0	12.4	11.9
4813	AB-Mistahia Regional Health Authority	711	86	11.8	13.0	12.3
4814	AB-Peace Regional Health Authority	383	21	13.5	15.3	12.7
4815	AB-Keeweenaw Regional Health Authority	496	24	16.4	19.3	16.5

## Regional socio-economic context and health

Health region		Size		Proportion reporting fair or or poor health		
		Sample	1996 population ('000)	Unadjusted (%)	Age standardized (%)	Adjusted for individual characteristics (%)
Code	Name					
4816	AB-Northern Lights Regional Health Authority	530	37	8.4	13.7	13.4
4817	AB-Northwestern Regional Health Authority	308	18	16.8	18.3	13.5
5901	BC-East Kootenay	583	79	13.3	12.9	13.2
5902	BC-West Kootenay-Boundary	642	82	18.5	17.3	16.3
5903	BC-North Okanagan	822	114	12.3	11.4	11.5
5904	BC-South Okanagan Similkameen	955	221	15.4	13.8	14.7
5905	BC-Thompson	873	130	14.8	14.7	15.0
5906	BC-Fraser Valley	995	231	15.1	14.9	15.3
5907	BC-South Fraser Valley	1,272	543	12.9	13.2	15.6
5908	BC-Simon Fraser	1,057	303	12.0	12.2	14.6
5909	BC-Coast Garibaldi	593	73	11.0	10.7	12.6
5910	BC-Central Vancouver Island	960	233	13.4	12.0	13.0
5911	BC-Upper Island / Central Coast	669	119	12.2	11.8	14.5
5912	BC-Cariboo	611	73	15.8	16.2	15.1
5913	BC-North West	567	90	11.2	12.0	13.4
5914	BC-Peace Liard	533	65	10.9	12.6	13.2
5915	BC-Northern Interior	798	129	12.3	14.5	14.6
5916	BC-Vancouver	1,200	546	13.9	14.3	15.9
5917	BC-Burnaby	791	187	13.3	13.7	15.4
5918	BC-North Shore	767	177	6.9	7.2	11.1
5919	BC-Richmond	731	155	14.2	14.4	15.4
5920	BC-Capital	1,113	332	13.3	12.2	14.2
6001	Yukon	722	32	10.7	11.5	13.8
6101	Northwest Territories	865	42	14.2	18.1	13.7
6201	Nunavut	578	26	11.8	17.0	8.5
<b>Canada</b>						
	<b>Total</b>	<b>118,283</b>	<b>29,653</b>	<b>12.8</b>	<b>12.8</b>	<b>12.8</b>
	<b>Minimum</b>	<b>296</b>	<b>18</b>	<b>6.8</b>	<b>7.2</b>	<b>8.5</b>
	<b>Maximum</b>	<b>2,495</b>	<b>2,463</b>	<b>22.3</b>	<b>21.6</b>	<b>17.7</b>
	<b>Range</b>	<b>2,199</b>	<b>2,445</b>	<b>15.5</b>	<b>14.4</b>	<b>9.2</b>

Data source: Canadian Community Health Survey, cycle 1.1, 2000/01

## Definitions:

### Individual level

**Fair or poor health:** The health outcome variable is derived from a question on the Canadian Community Health Survey that measures self-reported health status "In general, would you say your health is excellent, very good, good, fair, or poor?" Responses were categorized into two groups: fair or poor and excellent, very good, or good. Self-assessment of health is recognized as a straightforward concept to administer; it is also a reliable and valid measure of health and has good predictive power.<sup>24-26</sup>

**Reference Group:** In multilevel studies, effects are usually presented as odds or deviations from a reference group. Here, the reference group is defined as the median category of each variable studied. A person belonging to the reference group was a middle-aged (age 30 to 44), upper-middle income woman with some post-secondary education, did not smoke, who was not obese, and who exercised at least four times per month.

**Age:** Respondents were grouped into four age groups: 18-29, 30-44, 45-64, and 65 or older.

**Education:** Respondents were grouped into four categories based on the highest level attained as of the completion of the first cycle of the CCHS: less than secondary graduation, secondary graduation, some post-secondary education, or post-secondary diploma or degree.

**Household income:** Household income was grouped into five categories defined by the number of people in the household and the total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 to 4 5 or more	Less than \$10,000 Less than \$15,000
Lower-middle	1 or 2 3 or 4 5 or more	\$10,000 to \$14,999 \$10,000 to \$19,999 \$15,000 to \$29,999
Middle	1 or 2 3 or 4 5 or more	\$15,000 to \$29,999 \$20,000 to \$39,999 \$30,000 to \$59,999
Upper-middle	1 or 2 3 or 4 5 or more	\$30,000 to \$59,999 \$40,000 to \$79,999 \$60,000 to \$79,999
Highest	1 to 2 3 or more	\$60,000 or more \$80,000 or more

**Daily smoker:** Respondents were classified as daily smokers if they reported smoking cigarettes daily.

**Occasional smoker:** Respondents were classified as occasional smokers if they reported smoking cigarettes occasionally.

**Obese:** Body mass index (BMI) is commonly used to determine if an individual is in a healthy weight range. BMI is calculated by dividing weight in kilograms by the square of height in metres. In this analysis, people with a BMI of 30 or more were classified as obese, a definition of obesity that is endorsed by the World Health Organization. The obesity measure is calculated for the population aged 20 or older. Pregnant women were excluded in the calculation of obesity rates.

**Infrequent Exerciser:** Physical activity is based on the number of times in the previous 3 months that respondents participated in leisure-time physical activity lasting more than 15 minutes. Monthly frequency was the number of times in the past 3 months divided by 3. Respondents were classified as infrequent exerciser if the number of times per month was three or less.

### Health region level

**Health region:** In general, health regions correspond to the administrative areas established by provincial authorities for local delivery of health and social services. At the time the CCHS was designed, there were 139 health regions in Canada. However, the CCHS does not collect data for two of these: the Région des Terres-Cries-de-la-Baie-James and the Région du Nunavik, both in the province of Québec. Furthermore, two health regions (Burntwood and Churchill, both in Manitoba) were combined because of Churchill's small population. The analytical file contains 136 health regions.

**Synthetic factors:** The synthetic factors "Remote," "Prosperous," "Cosmopolitan," and "Disadvantaged" are linear combinations of the 21 original variables, each representing a separate subset of these variables. Signs between parentheses indicate the direction of the association between synthetic variable and the main demographic and socio-economic variables of which it is composed.

**Remote:** Synthetic factor encompassing 8 variables, which represent the degree of remoteness of the health regions from large urban centers:

**Male-female ratio (+):** Total number of males in a given health region in 1996 divided by total number of females.

**Population < 15 (+):** Proportion of the population younger than 15.

**House inaffordability (-):** Proportion of households spending more than 30% of total household income on shelter.

**Education 25-54 (-):** Proportion of the population aged 25 to 54 with a post-secondary degree, certificate, or diploma.

**Population ≥ 65 (-):** Proportion of the population aged 65 or older.

**MIZ (metropolitan influenced zone) (-):** Proportion of population living in census metropolitan areas (CMAs), census agglomerations (CAs), and communities that fall outside CMAs/CAs in which at least 30% of the employed labour force commutes to the CMAs/CAs. The measure is used to describe the degree of urban influence in the health region. CMAs and CAs are large urban areas, together with adjacent urban and rural areas that have a high degree of economic and social integration with that urban area. CMAs and CAs are defined as urban areas that have attained certain population thresholds: 100,000 for CMAs and 10,000 for CAs.

**Aboriginal (+):** Aboriginal people living in a geographic area as a percentage of the total population.

**Frost-free days (-):** Average annual number of days with a temperature above 5°C.

**Prosperous:** Synthetic factor encompassing five variables, which represent the degree of economic prosperity of health regions:

**Government transfers (-):** Payments from federal programs such as Guaranteed Income Supplement/Old Age Security, the Canada Pension Plan, and Employment Insurance.

**Internal migration (+):** Proportion of the population that lived in a different census subdivision (municipality) at the time of the previous census (1991). Canadians living in households outside Canada, such as military and government personnel, are excluded.

**Population change (+):** Change in the population size between 1995 and 1997 (as a percentage).

**Unemployment (-):** Number of unemployed persons aged 15 or older divided by the total number of persons aged 15 or older participating in the labour force.

**Average income (+):** Average post-transfer, pre-tax personal income from all sources, for people aged 15 or older.

**Cosmopolitan:** Synthetic factor encompassing five variables, which represent the degree of urbanization and ethnicity of health regions:

**Recent immigration (+):** Proportion of individuals who came to Canada between 1981 and 1996 among total of immigrants.

**Population density (+):** Number of people per square kilometre.

**Population size (+):** Proportion of the Canadian population within a health region.

**Dwelling values (+):** Average expected value of an owner-occupied, non-farm, non-reserve dwelling, including land, at the time of the 1996 Census.

**Visible minority (+):** Proportion of population belonging to a visible minority group as a percentage of the total population.

**Disadvantaged:** Synthetic factor encompassing three variables, which represent the degree of social and economic disadvantage of health regions:

**Income equality (-):** Proportion of total household income in the less well-off 50% of households within a geographic area (that is, the "median share" of income). In a situation of complete inequality, the bottom half receives 0, and the top half 100%, of all income. With total equality, the bottom half of the income distribution receives 50% of the total income, and the geographic area then has a median share value of 50%. In this range from 0 to 50%, lower median values indicate less equal income distributions.

**Lone-parent families (+):** Proportion of lone-parent families, among all census families living in private households.

**Owner-occupied household (-):** Proportion of dwellings in which the owner lives. Band housing and collective dwellings are excluded from both numerator and denominator.