
Statistical modelling of mental distress among rural and urban seniors

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Abstract

The senior population is growing rapidly in Canada. Consequently, there will be an increased demand for health care services for seniors who have mental illness. Seniors are more likely to live in rural areas than younger people; therefore, it is important to identify the differences between rural and urban seniors in order to design and deliver mental health services. The main objective of this paper was to use the National Population Health Survey (NPHS) to examine the differences with regard to mental distress between rural and urban seniors (i.e. 55 years and older). The other objectives were to investigate the long-term association between smoking and mental health and the long-term association between unmet health care needs and the mental health of seniors in rural and urban areas. The mental distress measure was examined as a binary outcome. The analysis was conducted using a generalized estimating equation approach that accounted for the complexity of a multi-stage survey design. Rural seniors reported a higher proportion of mental distress [OR = 1.16; 95% CI: 0.98, 1.37] with a borderline statistical significance than urban seniors. This finding was based on a final multivariate model to study the relationship between mental distress and location of residence (i.e. rural or urban) as well as between smoking and self-perceived unmet health care needs, adjusting for other important covariates and missing outcome values. A significant correlation was noted between smoking and mental health problems among seniors after adjusting for other covariates [OR = 1.26; 95% CI: 1.00, 1.60]. Participants who reported self-perceived unmet health care needs reported a higher proportion of mental distress [OR = 1.72; 95% CI: 1.38, 2.13] compared to those who were satisfied with their health care.

\$14.4 billion.⁶ By 2020, depression will be the second leading cause of the overall world illness burden, after ischemic disease.⁷⁻⁸ Advances in neuroscience and behavioural medicine have shown that mental disorders are the result of complex interactions among biological, psychological and social factors.⁸ There has been adequate research on the mental health of rural seniors, but very few rural-urban comparison studies have been conducted on seniors. It is important to identify differences between rural and urban seniors in order to design and deliver appropriate mental health services. Proper statistical analysis of available national longitudinal datasets allows for the investigation of important risk factors for mental distress. These factors can lead us to identify high-risk groups at early stages and will help us target our preventive measures to lessen the future economic burden on the health care system.⁹

Key words: *mental health, rural seniors, longitudinal data, National Population Health Survey, generalized estimating equations, bootstrap weights, missing data*

The authors of this paper will use the National Population Health Survey (NPHS)¹⁰ from Statistics Canada to examine (1) the rural and urban differences in mental distress; (2) the long-term association between smoking and mental distress; and (3) the long-term association between unmet health care needs and mental health among seniors who live in rural and urban areas. Urban areas are defined as continuously built-up areas with a population concentration of 1000 or more, and a population density based on the previous census¹¹ of 400 or more people per square kilometre; other areas are defined as rural.

Introduction

Seniors are one of the fastest growing population groups in Canada, as reported by Statistics Canada. By 2021, there will be almost seven million seniors (i.e. 65 years of age or older), representing 19% of the population.¹ Seniors are more likely than younger people to live in rural areas (24% versus 21%) and are also more likely to reside in smaller urban areas.¹ Rural seniors often live in isolation, and due to a lack of social interaction, they may be at a higher

risk of developing mental health problems compared to their urban counterparts. Furthermore, this isolation may increase the likelihood of rural seniors reporting lifestyle habits such as smoking and alcohol consumption, which helps aggravate mental health problems.²⁻⁴ Mental illness accounts for 30% of disability claims, i.e. \$15 to \$33 billion annually in Canada.⁵ A recent Canadian study estimates that the annual cost of treated and non-treated mental health problems in Canada is

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Methods

Longitudinal NPHS dataset

Data from the National Population Health Survey (NPHS) were used in this analysis. The NPHS is a longitudinal study¹⁰ of a Canadian national sample. The original survey included 17 626 subjects sampled in 1994/95 (i.e. cycle 1), with the aim of following or recontacting them every 2 years for up to 20 years. To be included in the survey, respondents must have completed at least the general component of the questionnaire in 1994/95.¹² Except in the province of Quebec, the NPHS employed a stratified two-stage design (i.e. clusters and dwellings) based on the Labour Force Survey (LFS) from Statistics Canada. In Quebec, the NPHS sample was selected using a two-stage design similar to that of the LFS from dwellings participating in a health survey organized by Santé Québec (the 1992/1993 Enquête sociale et de santé [ESS]).¹³ Base sample sizes for each province were determined using the Kish allocation, which balanced the reliability requirements at national and provincial levels. A minimum of 1200 households in each province was needed to ensure a specified reliability by sex and broad age groups. Populations on First Nations reserves, on Canadian Forces bases and in some remote areas of Quebec and Ontario were excluded from the household components of the survey. Data were weighted to reflect the sample design, non-response adjustments and post-stratification.

The same individuals were surveyed repeatedly, which allowed for the investigation of the effects of baseline- and time-varying risk factors on longitudinal changes in mental health. Conclusions drawn from such longitudinal studies are stronger compared to cross-sectional studies, because some information on the sequence of events is available.¹⁴ In most situations, longitudinal data are incomplete. There are several approaches for the analysis of incomplete longitudinal data. A binary logistic regression model can be fitted using a method based on improbability, i.e. the Generalized Estimating Equation (GEE) approach,¹⁵ assuming that the dropouts are not missing completely at random (MCAR). Another approach for

analysis of incomplete longitudinal data are pattern mixture models formulated by Little,^{16–18} assuming that dropouts are not MCAR. The pattern mixture model is a solution to the non-response problem in survey data. The first step in applying the pattern mixture model approach is to divide the subjects into groups depending on their missing data pattern. If subjects are measured at six time points, then there are 64 (2⁶) possible missing data patterns. A between-subject variable is created by grouping the missing data patterns. This between-subject variable can be used in the longitudinal data analysis as another covariate. In this paper, pattern mixture models were examined with GEE-based models for National Population Health Survey data.

Distress scale: National Population Health Surveys (NPHS)

From the relatively wide range of mental health indicators available in the NPHS, we chose the distress measure based on a subset of items from the Composite International Diagnostic Interview (CIDI). The outcome of interest consisted of six questions developed by Kessler and Mroczek of the University of Michigan.¹⁹ The distress scale is comprised of various CIDI items that inquired about feelings of sadness, nervousness, restlessness, hopelessness, worthlessness and the feeling that everything was an effort.¹¹ Additional items clarified whether these symptoms occurred “a lot,” “somewhat,” “a little,” “more than usual,” “the same,” or “less than usual” compared to the previous month. Based on the above questions, a distress scale was derived for each of the six cycles. This derived variable determines the respondent’s distress scale. Scores on the distress scale range from 0 (i.e. no distress) to 24 (i.e. highly distressed). Details can be found in the NPHS derived variable directory.¹¹

Subpopulation

This study was limited to the population group aged 55 years and older as of the initial survey in 1994/95. There were 4444 participants in the subpopulation and 16 052 observations in the longitudinal analysis. The main factors of interest are location of residence, smoking status and drinking status. Other demographic and socio-economic variables in previous

mental health studies^{20–23} that are included in these analyses are sex, age, marital status, education level, total household income, self-reported general health index, geographical area, any chronic condition, physical activity within the last three months, and self-perceived unmet health care needs.

Modelling distress as a binary response

It was interesting to investigate how the response vector evolved over time and to observe how it related to a set of explanatory variables. The distress scale was highly skewed, and we decided to recode it according to the literature^{23–24} and the suggestions of a geriatric psychiatrist. As distress was recoded to a binary scale (i.e. categories: no/low [0–5 scale] and moderate/high [6–24 scale]), it seemed natural to consider a binary model. We fitted the GEE-based binary regression model^{25–26} using the GENMOD procedure in SAS.^{25–29} This procedure allowed us to select different specifications of working correlation matrices (i.e. independent, first-order autoregressive [AR(1)], exchangeable and unstructured). We selected the model with an unstructured covariance structure, which gave us the smallest standard errors.³⁰ The GENMOD is based on Liang and Zeger’s method,^{28–29} which accounts for the within-subject dependencies only, due to the repeated measurements over time. To account for the complexities of the multi-stage stratified clustered design, the bootstrap resampling method was used to calculate the correct variance around a given estimate. This was achieved using both the “Bootvar” SAS macro^{30–32} and the bootstrap weights provided by Statistics Canada.^{10,12} The “Bootvar” macro was modified to apply to the generalized estimating equations method.^{31,34} The approach used to study the effect of missing data was the GEE-based pattern mixture model.

Statistical analysis

Univariate analyses were conducted to examine the relationship between the distress scale and the main factors of interest, as well as demographic and socio-economic variables at $\alpha = 0.20$ significance level. The next step was to conduct the multivariable analysis to determine the effects of all potential covariates and/or interactions

on the distress scale. All potential covariates and interaction terms were included concurrently in the model. Variables that were significant at $\alpha = 0.05$ level or of scientific interest, as well as missing data patterns, were retained in the final model.

Results

In 1994, 20% of the general population of Canada were seniors. Among seniors, there were more female seniors (i.e. 56%) compared to male seniors. In rural populations, 22% of residents were seniors and in urban populations, 20% of residents were seniors. There was a higher percentage of male seniors (i.e. 53%) in rural areas, but a higher percentage of female seniors (i.e. 58%) in urban areas. Our main interest in conducting this analysis was to compare mental distress between rural and urban seniors. We started the statistical analysis by exploring these differences in baseline characteristics, presented in Table 1 and summarized below.

Comparison of mental distress between rural and urban seniors

The percentage of the moderate- or high-distress category among seniors was 17% in rural areas and 16% in urban areas, respectively. The proportion of the moderate- or high-distress category for all age categories varies from 12% to 25% for rural seniors and from 14% to 19% for urban seniors. In the moderate- or high-distress category, there was a slightly higher percentage (i.e. 22%) of rural female seniors compared to urban female seniors (i.e. 20%). In addition, female seniors had a higher distress level compared to male seniors in both rural and urban areas. The proportion of moderate or high distress levels was higher for rural seniors who were single, married, common-law spouses or in a partnership compared to their urban counterparts. Both rural and urban Quebec residents had a higher proportion of moderate or high distress than rural and urban seniors in other regions. In both rural and urban areas, respondents with low education levels had a higher proportion of moderate or high distress compared to post secondary graduates, and a higher proportion of respondents with low income were in this distress category than

high income seniors. Moreover, seniors who were less involved in social activities reported a higher proportion of moderate or high distress in both rural and urban areas. The seniors who were current smokers had a higher prevalence of moderate or higher distress in both rural and urban areas compared to non-smoking seniors. Non-drinkers had a higher proportion (i.e. 21%) of moderate or high distress compared to current drinkers in rural and urban areas.

There was a higher prevalence of moderate or high distress in respondents, (1) with any chronic condition compared to persons without a chronic condition; and (2), without any physical activity within the last three months compared to respondents with any physical activity. In addition, seniors with self-perceived unmet health care needs had a higher prevalence of moderate or high distress than those whose health care needs were perceived to have been met. This proportion was higher in urban areas (i.e. 49%) compared to rural areas (i.e. 43%).

Figure 1 illustrates the rural and urban comparison of self-perceived unmet health care needs. This suggests that seniors in rural areas were more likely to have unmet health care needs than their counterparts in urban areas from 1996 to 2002. This apparent increase over time could be due to aging. Figure 2 illustrates the reasons for not getting self-perceived needed health care for rural and urban seniors from 1994 to 2004. The most common reasons for not meeting the health care needs of rural seniors were difficult access to health professionals (i.e. 40%) and seniors choosing not to see health professionals (i.e. 25%). For their urban counterparts, the most common reasons for a lack of seniors' health care were difficult access to health professionals (i.e. 20%) and other reasons (i.e. 45%), which included too busy, didn't get around to it, didn't know where to go, transportation problems, language problems, and personal or family responsibilities. It was also interesting to note that both rural and urban seniors (i.e. 33% and 26%, respectively) who reported moderate or high distress were more likely (i.e. more than 6 times within past 12 months) to visit their family doctor.

Participants in rural areas were less likely to see their family doctor (i.e. 18%) compared to their urban counterparts (i.e. 14%).

Univariate analysis results

Analyses were conducted to examine the relationship between the distress scale, the main interest factors and the demographic and socio-economic variables mentioned above. The preliminary analysis showed that the variables of sex, education level, age group, marital status, income level, general health, geographic area, smoking status, any chronic condition, physical activity, self-perceived unmet healthcare needs and location of residence were related to the mental distress scale at significance level of $\alpha = 0.20$. Alcohol consumption was not shown as a risk for mental distress in the preliminary analysis and it was not used in the model.

Multivariable analysis results

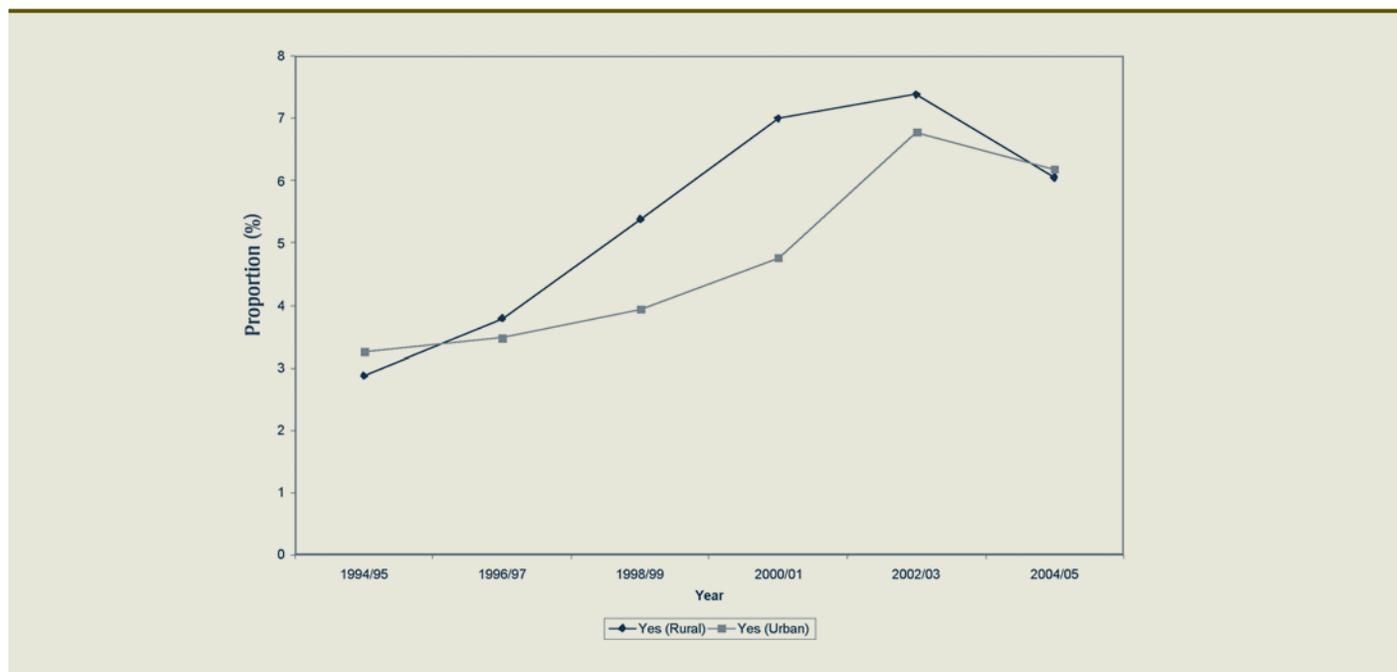
Table 2 explains the four missing patterns. We can contrast completers (i.e. those who completed all six cycles) versus those who missed one cycle, completers versus those who missed two or more cycles, and completers versus people who died within six cycles.

We included the missing patterns and covariates to the multivariate model. This multivariate analysis was based on a generalized estimating equations approach, with the results given in Table 3. This model is called GEE-based pattern mixture model. In this analysis, several important interaction terms were tested (i.e. sex and smoking, sex and physical activity, etc.) and none were significant.

Included in the model for the purpose of the generalized estimating equations procedure were age, sex, marital status, location of residence, geographic area, income level, education level, smoking status, general health status, any chronic condition, physical activity within the last three months and self-perceived unmet health care needs.

All of these variables were retained for the final model of the relationship between covariates and mental distress among

FIGURE 1
Self-perceived unmet health care needs of rural and urban seniors over time



seniors (i.e. 55 years and older). The odds ratios reported for all covariates predicting mental distress took into account the relationship of each of these variables with each outcome at each cycle. All reported odds ratios were adjusted for all other variables in the model. The odds ratios demonstrate the likelihood that those with poor self-rated general health status would have greater mental distress compared to those with excellent self-rated general health status. This takes into account the changes in the status of self-rated general health over a two-year follow-up period to produce an overall estimate of the association for each relationship. A similar interpretation can be applied to each of the other variables in the model for mental distress.

The following results were obtained based on the final multivariate model used to study the relationship between location of residence, smoking and mental distress, adjusting for other important covariates and the pattern of missing data. Rural seniors (i.e. 55 years and older) reported a higher proportion of mental distress [OR = 1.16; 95% CI (0.98 to 1.37)] than urban seniors. A significant association was evident among seniors with mental health problems and smoking after adjusting for other covariates

[OR = 1.26; 95% CI (1.00 to 1.60)]. Senior non-completers had significantly higher proportions of mental distress compared to completers [OR = 1.44 (1.13 to 1.82), OR = 1.39 (1.10 to 1.76) and OR = 1.68 (1.36 to 2.06) respectively]. A significantly higher proportion of female participants reported mental distress compared to male participants [OR = 1.79 (1.47 to 2.17)]. Separated, widowed or divorced participants reported a significantly higher proportion of mental distress compared to single participants [OR = 1.48 (1.08 to 2.03)]. Participants from Quebec reported a significantly higher prevalence [OR = 1.57 (1.20 to 2.06)] of distress compared to Ontario participants, while Atlantic residents reported a lower prevalence [OR = 0.68 (0.53 to 0.87)] of distress compared to Ontario participants. Senior participants who did not complete their secondary school education had a higher prevalence [OR = 1.36 (1.07 to 1.72)] of distress compared to post-secondary graduates. Participants who reported their general health index as “poor,” “fair” or “good” had a higher prevalence of mental distress compared to those who reported “excellent” general health. Senior participants who had any kind of chronic condition had a higher prevalence of mental distress [OR = 1.60 (1.29 to 1.99)] compared to those without

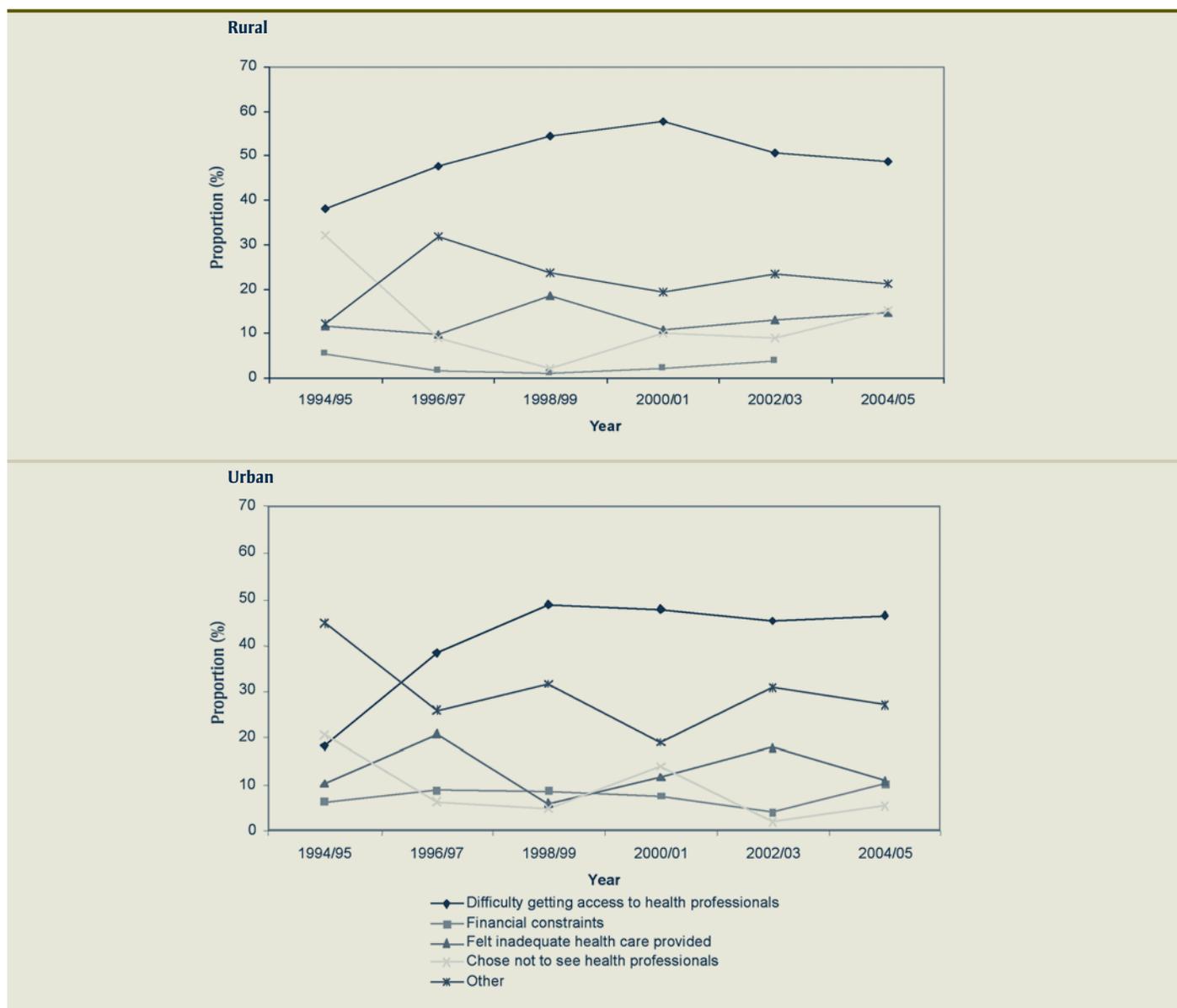
chronic conditions. Participants who had engaged in physical activity within the last three months had a lower prevalence [OR = 0.82 (0.70 to 0.95)] of mental distress compared to those who had not. For variety of reasons, participants who reported self-perceived unmet health care needs had a higher proportion of reporting mental distress compared to those who reported satisfied health care needs [OR = 1.72 (1.38 to 2.13)]. The highest proportion of respondents listed the main reason for unsatisfied health care needs as difficulty getting access to health care professionals.

The model, adjusted for the pattern of missing values, is presented here. With and without adjusting for missing values, there were slight differences in parameter estimates, standard errors and ORs. Therefore, a GEE-based pattern mixture model helps us to remove the bias of estimates due to missing outcome values.

Discussion

Until now, there has been no proper statistical analysis of the mental health of Canadian seniors that accounts for both the complexities of longitudinal NPHS data (i.e. six cycles) and the hierarchical nature formed by using a multi-stage complex

FIGURE 2
Reasons for not getting needed health care in rural and urban areas



survey design. Moreover, this analysis was adjusted for missing outcome values, which will remove the bias of estimates. There were significant differences among baseline characteristics (i.e. sex, marital status, geographic areas, education level, income level, social support, smoking status, drinking status, general health index, physical activity and self-perceived unmet health care needs) and among location of residence (i.e. urban and rural).

We observed that rural seniors reported a higher proportion of high mental distress than urban seniors. In addition, there was

a significant long-term association between smoking and mental distress. Our results revealed that there was a significant long-term association between self-perceived unmet health care needs and mental health among seniors (i.e. 55 years and older) who live in both rural and urban areas.

Most mental health studies using longitudinal data sets as afforded by the NPHS have focussed on depression. In our study, the outcome is mental distress. Other findings of our study were consistent with those studies. Stephens et al.²² reported that there is no relationship between mental

health and adequate incomes; our results also revealed this finding. According to Stephens et al.,²³ physical and mental health problems were related. We also observed that respondents who reported lower general health status were associated with mental distress. Our observation of better mental health in males than in females was consistent with the findings of Stephens et al.²³ and Østbye et al.³⁵ Similar to the findings of Stephens et al.,²³ chronic physical health problems were closely associated with mental health.

TABLE 1
Baseline demography and other information by location of residence for 1994

	Mental health (moderate/high) – rural counterparts	Mental health (moderate/high) – urban counterparts	<i>p</i> -value
Demographic information			
Age group			
55 to 59	19.1	15.7	< 0.0001
60 to 64	13.5	17.4	< 0.0001
65 to 69	16.6	14.8	< 0.0001
70 to 74	12.5	16.3	< 0.0001
75 to 79	24.6	13.8	< 0.0001
80 and older	18.2	19.4	0.1579
Sex			
Male	11.8	11.0	< 0.0001
Female	22.2	19.8	< 0.0001
Marital Status			
Married/common-law/partnership	17.1	13.7	< 0.0001
Separated/widowed/divorced	14.5	21.6	< 0.0001
Single	22.6	13.9	< 0.0001
Geographical area			
Atlantic	19.8	12.0	< 0.0001
Quebec	24.7	23.0	< 0.0001
Ontario	13.1	14.4	< 0.0001
Prairies	14.6	14.9	0.0039
British Columbia	10.2	11.3	< 0.0001
Socio-economic status			
Education level			
Less than secondary school graduation	19.1	22.5	< 0.0001
Secondary school graduation	13.9	13.1	< 0.0001
Some post-secondary	13.8	10.5	< 0.0001
Post-secondary graduation	13.5	11.1	< 0.0001
Income level			
Low	22.7	22.7	1.0000
Middle	16.6	14.8	< 0.0001
High	4.4	10.7	< 0.0001
Social support			
Social involvement score			
Low	19.6	19.6	1.0000
Moderate	16.4	16.8	< 0.0001
High	15.1	11.4	< 0.0001
Lifestyle			
Smoking status			
Current smoker	19.2	20.5	< 0.0001
Ex-smoker	15.5	15.5	1.0000
Non-smoker	17.4	14.7	< 0.0001

TABLE 1 (continued)
Baseline demography and other information by location of residence for 1994

	Mental health (moderate/high) – rural counterparts	Mental health (moderate/high) – urban counterparts	p-value
Drinking status			
Current drinker	15.5	13.7	< 0.0001
Ex-drinker	19.1	21.3	< 0.0001
Non-drinker	21.3	21.2	0.4252
Health-related:			
General health status			
Poor	65.1	58.9	< 0.0001
Fair	32.0	33.5	< 0.0001
Good	13.6	14.5	< 0.0001
Very good	6.4	6.2	< 0.0001
Excellent	2.2	7.3	< 0.0001
Any chronic condition?			
Yes	18.8	18.8	0.2812
No	10.9	7.6	< 0.0001
Physical activity within the last three months?			
Yes	14.3	14.7	< 0.0001
No	31.5	24.1	< 0.0001
Self-perceived unmet health care needs			
Yes	42.5	48.9	< 0.0001
No	16.2	15.0	< 0.0001
Reasons for not getting health care†			
Difficulty getting access to health professionals	47.2	61.5	
Financial constraints	F*	30.8	
Felt inadequate health care provided	F*	31.7	
Chose not to see health professionals	29.2	30.2	
Other	66.1	58.2	
Number of consultations – family doctor within last 12 months			
None	11.9	8.2	< 0.0001
1 to 6 times	13.4	15.1	< 0.0001
More than 6 times	32.8	25.8	< 0.0001

F* - Due to confidentiality small percentages are not reported.

†p-values are not reported.

TABLE 2
Missing distress data patterns over six cycles

Description	Percentage
Completed all six cycles	38.43
One cycle missing	11.87
Two or more cycles missing	20.80
People who died within six cycles	28.90

TABLE 3
Odds ratio (OR) and their 95% confidence interval (95% CI) based on multivariate binary logistics regression (GEE-based pattern mixture model) of the prevalence of mental distress

	OR (95% C.I.)	
Drop:	One missing	1.44 (1.13, 1.82)
	Two or more missing	1.39 (1.10, 1.76)
	Died within six cycles	1.68 (1.36, 2.06)
	Completers	Reference
Age Group:	55 to 59	1.76 (1.31, 2.35)
	60 to 64	1.49 (1.13, 1.97)
	65 to 69	1.21 (0.93, 1.59)
	70 to 74	1.07 (0.84, 1.38)
	75 to 79	1.01 (0.80, 1.27)
	80 and older	Reference
Sex:	Female	1.79 (1.47, 2.17)
	Male	Reference
Marital Status		
	Married/common-law/partnership	1.19 (0.87, 1.64)
	Separated/widowed/divorced	1.48 (1.08, 2.03)
	Single	Reference
Location of residence		
	Rural	1.16 (0.98, 1.37)
	Urban	Reference
Geographical area		
	Atlantic	0.68 (0.53, 0.87)
	Quebec	1.57 (1.20, 2.06)
	Ontario	Reference
	Prairies	1.00 (0.80, 1.25)
	British Columbia	0.87 (0.67, 1.13)
Socio-economic status		
Education level		
	Less than secondary school graduation	1.36 (1.07, 1.72)
	Secondary school graduation	1.28 (0.94, 1.73)
	Some post-secondary	1.11 (0.84, 1.47)
	Post-secondary graduation	Reference
Income level		
	Low	1.30 (0.89, 1.89)
	Middle	1.20 (0.88, 1.64)
	High	Reference
Life-style		
Smoking Status		
	Current smoker	1.26 (1.00, 1.60)
	Ex-smoker	1.10 (0.92, 1.31)
	Non-smoker	Reference

In contrast to the findings of Stephens et al.²³ about the province of residence, we found that there is a significant difference in the mental distress of seniors in some geographic areas. Participants from Quebec reported a high proportion of high mental distress compared to their Ontario participants; Atlantic residents reported a lower proportion of high mental distress compared to their Ontario participants.

There is a possibility of reverse causation, which is shown by other researchers.³⁶⁻⁴⁰ Murphy et al.³⁶ reported that smoking at baseline was not related to a subsequent incidence of depression. In addition, they found that participants who become depressed are more likely to begin or continue smoking compared to participants who never become depressed. Lasser et al.³⁹ reported that persons with mental health problems are about twice as likely to smoke. Saffer et al.⁴⁰ found that persons with a history of mental health problems are 94% more likely to smoke compared to persons with no history of mental health problems. This paper focused on investigating the long-term association between mental health and smoking. To determine the direction of any causation, a special analysis is required. The NPHS measures self-reported, unmet health care needs by asking, "During the past 12 months, was there ever a time when you felt that you needed health care, but you didn't receive it?" A "yes" response was tabulated as an unmet need. Because of the wording of the question addressing unmet needs, it is not possible to distinguish situations in which people did not receive services at all from situations in which they were not received in a timely manner. Chen et al.⁴¹ (2002) and Sanmartin et al.⁴² (2002) reported that individuals with chronic conditions, including pain or distress were more likely to report problems with the health care delivery system. Several studies⁴³ of seniors' health reported that the health care system only marginally improved the overall health of the senior population. Our results, which correspond with the findings of the above studies, suggested a possible reverse causation. In this sense, the unmet needs are the effect of the distress, not the cause. To determine the direction of any causation, further analysis is required.

TABLE 3 (continued)
Odds ratio (OR) and their 95% confidence interval (95% CI) based on multivariate binary logistics regression (GEE-based pattern mixture model) of the prevalence of mental distress

	OR (95% C.I.)
Health-related:	
General health status	
Poor	12.14 (7.69, 19.18)
Fair	5.26 (3.51, 7.88)
Good	2.74 (1.85, 4.06)
Very good	1.31 (0.89, 1.95)
Excellent	Reference
Any chronic condition*	
Yes	1.60 (1.29, 1.99)
No	Reference
Physical activity within the last three months	
Yes	0.82 (0.70, 0.95)
No	Reference
Self-perceived unmet health care needs	
Yes	1.72 (1.38, 2.13)
No	Reference

* denotes one or more chronic conditions

These results can be used to improve the design and delivery of mental health services to rural and urban seniors. The results can also be used to target methods to reduce smoking among seniors who live in rural and urban areas, and address the causes of unmet health care needs. Better design and delivery of services may result in cost savings in terms of seniors' psychotherapy appointments, emergency room visits, medication use and consequent productivity loss.

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References

1. Public Health Agency of Canada. Statistical snapshots of Canada's seniors - No. 1 - No. 37 [Internet]. Ottawa: Public Health Agency of Canada; 2005. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/factoids/2001/toc_e.htm

2. BC Partners for Mental Health and Addictions Information. The primer: facts sheets on mental health and addictions issues [Internet]. British Columbia: Canadian Mental Health Association - British Columbia Division; 2003. 127 p. Available from: www.bcss.org/documents/primer.pdf

3. Stotts RC, Smith CK. Smoking patterns among rural elderly [Internet]. South J Nurs Res. 2002; 3(4):1-14. Available from: http://www.snrs.org/publications/SOJNR_articles/iss04vol03.htm#inter

4. Spencer C. Older adults, alcohol and depression [Internet]. National project report: seeking solutions: Canadian community action on seniors and alcohol issues. Vancouver: Gerontology Research Centre, Simon Fraser University; 2003 May. Available from: http://www.agingincanada.ca/Alcohol and Depression_7.pdf

5. Dewa CS, Lesage A, Goering P, Caveen M. Nature and prevalence of mental illness in the work place. Healthc Pap. 2004; 5(2):12-25.

6. Stephens T, Joubert N. The economic burden of mental health problems in Canada. Chronic Dis Can. 2001;22(1):18-23.

7. Murray CJL, Lopez AD, eds. The global burden of disease: A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Vol. 1. Cambridge (MA): Harvard University Press; 1996. 990 p.

8. World Health Organization. The world health report 2001 - mental health: new understanding, new hope. Geneva: World Health Organization; 2001. 178 p.

9. Stephens T, Joubert N. The economic burden of mental health problems in Canada. Chronic Dis Can. 2001; 22(1):18-23.

10. Statistics Canada. National population health survey - household component, cycle 6 (2004/2005): longitudinal documentation [Internet]. Ottawa: Statistics Canada; 2006. Available from: www.statcan.gc.ca/imdb-bmdi/document/3225_D5_T1_V3-eng.pdf

11. Statistics Canada. National population health survey - household component, cycle 6 (2004/2005): documentation for the derived variables and the constant longitudinal variables [Internet]. Ottawa: Statistics Canada; 2006. Available from: www.statcan.gc.ca/imdb-bmdi/document/3225_D10_T9_V2-eng.pdf

12. Statistics Canada. Public use microdata file (PUMF): national population health survey - 1994-1995. Ottawa: Statistics Canada; 1995. 64 p.

13. Bellerose C, Lavallée C, Tremblay D. Cahier technique et méthodologique. Enquête sociale et de santé 1992-1993. Vol. 1, Montréal: Gouvernement du Québec, Ministère de la Santé et des Services sociaux; 1995. 134 p.

14. Buckley NJ, Denton FT, Robb AL, Spencer BG. Socio-economic influence on the health of older people: estimates based on two longitudinal surveys. Hamilton: Research Institute for Quantitative Studies in Economics and Population (QSEP); 2003. Report No.: 387.

15. Michiels B, Molenberghs GM, Bijmens L, Vangenengden T, Thijs H. Selection models and pattern mixture models to analyze longitudinal quality of life data subject to dropout. *Stat Med.* 2002;21:1023-41.
16. Little RJ, Rubin DB. *Statistical analysis with missing data. Chapters 14 and 15.* New York: John Wiley and Sons; 2002. p. 292-348.
17. Little RJ. Pattern – mixture models for multivariate incomplete data. *J Am Stat Assoc.* 1993;88:125-34.
18. Little RJ. A class of pattern–mixture models for normal missing data. *Biometrika.* 1994;81:471-83.
19. Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. Ann Arbor (MI): Survey Research Centre of the Institute for Social Research, University of Michigan. Memo dated March 10, 1994.
20. Patten SC, Beck CA. Major depression and mental health care utilization in Canada: 1994-2000. *Can J Psychiatry.* 2004;49(5): 303-9.
21. Wang J, El-Guebaly N. Sociodemographic factors associated with comorbid major depression episodes and alcohol dependence in the general population. *Can J Psychiatry.* 2004 Jan;49(1):37-44.
22. Wilkins K, Beaudet MP. Work stress and health. *Health Rep.* 1998;10(3):47-62.
23. Stephens T, Dulberg C, Joubert N. Mental health of the Canadian population: a comprehensive analysis. *Chronic Dis Can.* 2000;20(3):118-26.
24. Baggaley RF, Ganaba R, Fillippi V, Kere M, Marshall T, Sombie I, Storeng KT, Patel V. Detecting depression after pregnancy: the validity of the K10 and K6 in Burkina Faso. *Trop Med Int Health.* 2007;12(10):1225-9.
25. Allison, PD. *Logistic regression using SAS: theory and application.* Cary (NC): SAS Institute; 1999. p. 5-78, 179-213.
26. SAS Institute Inc. *SAS/STAT 9.1 user's guide.* Cary (NC): SAS Institute Inc.; 2005. 5136 p. Available from: http://support.sas.com/documentation/onlinedoc/91pdf/index_913.html
27. Diggle PJ, Liang K-Y, Zeger SL. *Analysis of longitudinal data.* New York: Oxford University Press; 1994. 253 p.
28. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized estimating equations. *Biometrika.* 1986;73:13-22.
29. Zeger SL, Liang K-Y. Longitudinal data analysis for discrete and continuous outcomes. *Biometrics.* 1986;42:121-30.
30. SAS Institute Inc. *Longitudinal data analysis with discrete and continuous responses: instructor based training.* Cary (NC): SAS Institute Inc.; 2002. p. 3-32.
31. Statistics Canada. *Estimation of the variance using the bootstrap weights. User's guide for the BOOTVARE_V21.SPS program.* Version 2.1. Ottawa: Statistics Canada; 2005.
32. Rao JN. Interplay between sample survey theory and practice: an appraisal. *Surv Methodol.* 2005;31(2):117-38.
33. Binder DA, Roberts GR. *Statistical inference in survey data analysis: where does the sample design fit in?* Paper presented at: Statistics Canada Research Data Centre Conference Program, University of McMaster; 2003 Sep 24-25; Hamilton, ON. [cited 2008 Mar 05]. Available from: <http://socserv.socsci.mcmaster.ca/rdc2003/binderoberts.pdf>
34. Fleming SA, Bains N, Hunter DJ, Lam M. Social support and health care use among a sample of healthy Canadians: a longitudinal analysis of the national population health survey. Kingston (ON): Health information partnership, Eastern Ontario Region; 2004. 58 p.
35. Østbye T, Kristjansson B, Hill G, Newman SC, Brouwer RN, NcDowell I. Prevalence and predictors of depression in elderly Canadians: the Canadian study of health and aging. *Chronic Dis Can.* 2005;26(4):93-9.
36. Murphy JM, Horton NJ, Monson RR, Laird NM, Sobol AM, Leighton AH. Cigarette smoking in relation to depression: historical trends from the Sterling Country Study. *Am J Psychiatry.* 2003;160:1663-9.
37. Anda RF, Williamson DF, Escobedo LG, Mast EE, Giovino GA, Remington PL. Depression and the dynamics of smoking: a national perspective. *JAMA.* 1990;264(12): 1541-5.
38. Hughes JR, Hatsukami DK, Mitchell JE, Dahlgren LA. Prevalence of smoking among psychiatric outpatients. *Am J Psychiatry.* 1986;143:993-7.
39. Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: a population-based prevalence study. *JAMA.* 2000; 284(20):2606-10.
40. Saffer H, Dave D. *Mental illness and the demand for alcohol, cocaine and cigarettes.* Economic Inquiry, Oxford University Press, 2005 April; Vol. 43(2):229-246.
41. Chen J, Hou F. *Unmet needs for health care.* Health Rep. Ottawa: Statistics Canada; 2002. 2002;13(2)23-34. Catalogue. No.: 82-003-XIE.
42. Sanmartin C, Houle C, Tremblay S, Berthelot JM. *Changes in unmet health care needs.* Health Rep. 2002;13(3):15-21. Catalogue. No.: 82-003-XIE.
43. Martin-Matthews A. *Sharing the learning: Health transition fund: Synthesis series.* Ottawa: Health Canada; 2002. Catalogue No: H13-6/2002-7.