Résumé

Les différences en matière de santé mentale entre des travailleurs d'âge moyen œuvrant dans une scierie rurale et des travailleurs en milieu urbain, en Colombie-Britannique

**Aleck Ostry, Stefania Maggi, Ruth Hershler,
Lisa Chen, Clyde Hertzman**

Cette étude a pour objectif de cerner les différences observables en matière de santé mentale entre une cohorte de travailleurs ruraux et une cohorte de travailleurs urbains, dans la province canadienne de la Colombie-Britannique. L'étude s'appuie sur une cohorte de travailleurs masculins œuvrant dans une scierie, laquelle comporte un lien probabiliste avec la BC Linked Health Database [base de données en matière de santé portant sur la population de la C.-B.] pour assurer l'objectivité des résultats en matière de santé mentale. Les chercheurs s'appuient sur l'utilisation de cas-témoins nichés et ont conçu des modèles uni- et multi-variables axés sur la régression logistique conditionnelle. Bien que les résultats diffèrent selon le résultat particulier en santé mentale, les chercheurs constatent, après avoir vérifié la présence de variables socioéconomiques confusionnelles, que les travailleurs qui demeurent ou migrent en région rurale affichent de meilleurs résultats sur le plan de la santé mentale, comparativement aux travailleurs demeurant ou migrant en milieu urbain.

Mots clés : santé mentale, rural, urbain, cas-témoins nichés

Mental Health Differences Among Middle-Aged Sawmill Workers in Rural Compared to Urban British Columbia

**Aleck Ostry, Stefania Maggi, Ruth Hershler,
Lisa Chen, Clyde Hertzman**

The study sought to determine whether differences in mental health outcomes were observable in a cohort of workers living in rural compared to urban places in the Canadian province of British Columbia. The study was based on a cohort of male sawmill workers. The cohort was probabilistically linked to the BC Linked Health Database in order to yield objective mental health outcomes. A nested case control design was used. Univariate and multivariate models were constructed using conditional logistic regression. While results differed according to the particular mental health outcome, after controlling for socio-economic confounders it was found that workers who remained in or migrated to rural places tended to have better mental health outcomes than workers who remained in or migrated to urban places.

Keywords: mental health, rural, urban, nested case control study, Canada

Introduction

There is a long history of research linking deterioration in social relations with urbanization and declining mental health among city dwellers (Fischer, 1976; Gaviria et al., 1986; Harpham, 1994; Leighton, 1959; Leighton, Harding, Macklin, Macmillan, & Leighton, 1963; Neff, 1983; Tofler, 1970; Wirth, 1938). While empirical evidence appears to support these results, many studies of rural/urban differences in mental health are methodologically flawed (Canadian Institute for Health Information, 2006; Fiona et al., 2002; Mueller, 1981).

This article reports on a methodologically rigorous study using objectively determined mental health outcomes in a cohort of current and former sawmill workers living in rural or urban places or migrating between rural and urban places in the Canadian province of British Columbia. We sought not only to investigate rural/urban differences in mental health among these workers but also to examine outcomes among workers who migrated from either urban or rural places.

Aleck Ostry, Stefania Maggi, Ruth Hershler, Lisa Chen, Clyde Hertzman

Literature Review

There is a small body of international literature comparing rural and urban mental health outcomes among adults. According to Fiona (2002) and Marsella (1998), results of most studies conducted prior to 2000 are difficult to interpret because of poor study design, mainly because they used inconsistent definitions of rurality, self-reported mental health out-comes, failed to control for SES (socio-economic status) confounders, and were cross-sectional. Nonetheless, except for a National Center for Health Statistics (1970) study, American studies conducted prior to the early 1990s found that people in cities were at greater risk for adverse mental illness than rural residents. The term "rural" was not defined consistently across these American studies (Blazer et al., 1985; Comstock & Helsing, 1976; Dohrenwend & Dohrenwend, 1974; Gaviria et al., 1986; Harpham, 1994; Leighton et al., 1963; Mueller, 1981; Neff, 1983; Robins, Helzer, Croughan, & Ratcliff, 1981; Toffler, 1970; Wirth, 1938).

Most American studies conducted since 1990 have also demonstrated a higher prevalence of mental illness in urban compared to rural places (Bourdon, Donald, Locke, Narrow, & Regier, 1992; Regier et al., 1993; Robins, Locke, & Regier, 1991). The exception is a large study by Kessler et al. (1994) that, while demonstrating significant regional differences across the United States in the lifetime prevalence of psychiatric disor-ders, found that "the effects of urbanicity at the county level are gener-ally not significant" (p. 15). This study had a very large sample size relative to previous American studies; it was nationally representative and was well designed, with control for socio-economic confounders.

In several British studies, the prevalence of depression (Brown & Prudo, 1981; Prudo, Brown, Harris, & Dowland, 1981) and psychiatric morbidity (Lewis & Booth, 1994; Paykel, Abbott, Jenkins, Brugha, & Meltzer, 2000) was found to be greater in urban compared to rural places. Similar results were found in the Netherlands (Bijl, Ravalli, & van Zessen, 1998). The results of two multinational European studies undertaken recently are more equivocal. Ayuso-Mateos et al. (2001) found a higher prevalence of depressive disorders in urban places in the United Kingdom and Ireland but not in Finland or Norway. In a representative survey of the adult population in Belgium, France, Germany, Italy, the Netherlands, and Spain, Kovess-Masféty, Alonso, de Graaf, Demyttenaere, and the ESEMeD 2000 Investigators (2005) found no difference in self-reported psychiatric disorders among urban and rural residents after con-trolling for potential SES confounders in four of the six nations surveyed. Finally, in a meta-analysis of 20 population-based studies conducted mainly in Europe and North America, Peen, Schoevers, Beekman, and Dekker (2010) found that for psychiatric disorders, mood disorders, and

anxiety disorders odds were higher and statistically significant in urban compared to rural places.

In Canada, one of the earliest studies of rural/urban differences in psychiatric morbidity was undertaken by Kovess, Murphy, and Tousignant (1987). These authors used DSM-III *(Diagnostic and Statistical Manual of Mental Disorders)* criteria to assess 6-month prevalence for major depressive episodes (MDEs). They were able to organize their analysis into a comparative investigation of urban, small town, and "pure" rural dwellers. The 6-month prevalence rates for MDE were 3.7 (per 100 people age 18 or older) in Montreal, 2.9 in the countryside, and 1.1 in the small town.

Results from the Ontario Health Survey (OHS) and the National Population Health Survey (NPHS) for 1994/95, 1996/97, and 1998/99 show that 1-year prevalence for MDE was always higher in urban compared to rural locales, ranging from 4.2% to 5.9% in urban places and from 3.2% to 4.8% in rural places across the surveys. The greatest difference was observed in the 1996/97 NPHS, which showed a rate of 5.1% in urban areas and 3.6% in rural areas (Patten, Wang, Beck, & Maxwell, 2005). Further analysis of the OHS results was undertaken by Parikh et al. (1996). The final sample consisted of 7,107 urban and 2,856 rural residents, representing one of the largest rural mental health samples ever studied. In this study, residents of the urban core and urban fringes of Census Metropolitan Areas or Census Agglomerations were designated as urban and the rest of the sample as rural. Twelve-month rates for MDE were 4.2% in urban and 3.2% in rural regions of the province, although this difference was not statistically significant. Wang (2004), using the NPHS definition for urban area (i.e., a minimum population of 400 per square kilometre, with all territories outside this area deemed rural), found the 12-month prevalence of MDE to be 4.6% in urban and 3.8% in rural regions. These results are similar to those found by Parikh et al. (1996) in Ontario, and are also not statistically significant.

The limited Canadian literature indicates consistent but small differences (often not statistically significant) in depression and MDE between urban and rural regions. The few analyses conducted in Canada that have controlled adequately for differences in socio-economic conditions in rural and urban regions indicate significantly higher odds for MDE among urban residents. Finally, all of these studies are limited by their focus on one psychiatric outcome: depression.

Methods

This study was based on a cohort of male sawmill workers. The cohort was gathered in two waves in the late 1980s and late 1990s originally to assess the effects of chlorophenol anti-sapstain exposure on mortality and

cancer outcomes among sawmill workers. Fourteen medium to large sawmills (i.e., employing 150 to 450 workers) were identified; some were located in urban and others in rural areas of British Columbia.

Research assistants were sent to each mill, where they viewed personnel records with data on job start and end dates and job titles held by employees while working at the mill. Any worker employed for at least 1 year in one of the 14 mills between 1950 and 1998 was included in the cohort, resulting in a final cohort of 28,794 workers. From personnel records, we obtained, for each cohort member, data on age, marital status (classified as *unmarried* [separated, divorced, single] or *married*), ethnicity (classified as *Caucasian, Sikh,* or *Chinese*), duration of employment at the mill, and detailed job title for each job held while employed at the mill.

There are approximately 50 basic job titles in a sawmill. For this analysis, these job titles were collapsed into four broad occupational status variables: manager, tradesman, skilled worker, and unskilled worker. No information was available in the personnel records for education or income. However, given that wages for jobs in sawmills are based on a fairly rigid pay structure negotiated and applied uniformly across all 14 mills, and given that these wages are largely based on the education and experience required to perform them, our four broad occupational categories are a reasonable proxy for the different levels of income and education found among cohort members.

Information on duration of employment was obtained from job title records, which described start date, end date, and job title for each job held by each worker while that person was employed at the mill. If a worker held many jobs while employed at a mill, duration of employment was calculated by summing across all job titles. For a detailed description of the original methods used in gathering this cohort, see Hertzman et al. (1997).

Obtaining Information on Mental Health Outcomes

Health information for each cohort member was obtained by probabilistic linkage to national mortality files. We also probabilistically linked each worker to the BC Linked Health Database (BCLHDB). This database consists of person-specific longitudinal records on all residents of British Columbia. The BCLHDB contains files on all births, utilization of physician services, and hospital discharges from 1985 to the present. It is managed according to the provisions of British Columbia's *Freedom on Information and Protection of Privacy Act*. Each file is stored separately but has been indexed with an individual service–recipient-specific code so that the records of groups of individuals can be linked across files for specific research projects.

There is evidence indicating that an individual's reaction to stressful life events may be mediated by genetic predispositions and may show familial predispositions (McGuffin, Katz, Aldrich, & Bebbington, 1988; Plomin, Lichtenstein, Pedersen, McClearn, & Nesselroade, 1990). However, the present work focused on those mental health outcomes that are thought to have a significant environmental component. There is evidence indicating that the social environment could contribute to the triggering of psychotic mental states but that it may not be the underlying cause of psychotic disorders (van Os, 2003). Accordingly, we excluded psychotic disorders from the analyses, which were instead focused on neurotic disorders, anxiety/depression, acute reaction to stress, and adjustment reaction.

Complete hospital diagnoses as well as physician visits for mental health conditions were available in the BCLHDB from January 1, 1994, to December 31, 2001. Cases eligible for selection over this 8-year period included all those with a first ICD9 diagnostic code of 292 (drug psychosis), 300 (neurotic disorder), 303 (alcohol dependence syndrome), 304 (drug dependence), 305 (non-dependent abuse of drugs), 308 (acute reaction to stress), 309 (adjustment reaction), and 311 (anxiety/depression). For reasons of statistical power it was necessary to obtain at least 300 cases per diagnostic code. Only four diagnostic codes met these criteria: 300, 308, 309, and 311.

In this study we focused on neurotic disorders, which are collections of psychiatric disorders without psychotic symptoms and lacking the intense psychopathology of depression; adjustment reaction, which is psychological response to an identifiable stressor or group of stressors that cause(s) significant emotional or behavioural symptoms that do not meet the criteria for anxiety disorder, post-traumatic stress disorder, or acute stress disorder; acute reaction to stress, which is a psychological condition arising in response to a traumatic event; and anxiety/depression.

Definitions of Rural and Urban

Of the 14 sawmills covered by the study, three situated in Greater Vancouver and one situated in Kelowna were designated "urban." The remaining 10, situated across the province, were in locations with under 100,000 population and were designated "rural."

Selection of Cases and Controls

For each case, we used postal codes available in the BCLHDB to identify the place where the person was living when diagnosed with a mental health outcome. We ascertained *rural* or *urban* location and *migration patterns* prior to diagnosis. To ensure consistency with our definitions of rural and urban, we then determined whether the population of the

place of diagnosis was under or over 100,000. If it was under 100,000, the place was classified as rural; if over 100,000, it was classified as urban.

In this way we were able to determine whether a case that originated at an urban mill had remained in the same urban location (urban stay) or had moved away from this mill (migrate from urban). Similarly, we determined whether a case that originated at a rural mill remained at the same location (rural stay), moved to an urban location (migrate rural to urban), or moved to another rural location (migrate rural to rural). This classification scheme therefore identified two types of case that were non-migrators (those who stayed in the same urban location and those who remained in the same rural location), as well as three types involving migration (rural dwellers who migrated away from their original urban location, rural dwellers who migrated to an urban place, and rural dwellers who migrated away from their original rural place to another rural place). Note that we did not determine whether the urban dwellers who migrated away from their original urban location moved to another urban place or to a rural one; we determined only that they migrated away from an urban location. Finally, for a few workers the migration pattern was impossible to ascertain because their postal codes after their mill employment were unavailable, likely because they had moved away from British Columbia; these were assigned the category of unknown migration status.

Analysis

Using STTOCC (survival time to case control) on Stata 8.0, we selected three controls for each case matched on age. Controls were chosen randomly with replacement from the set at risk — that is, all members of the cohort who worked in one of the 14 sawmills for at least 1 year. Thus a control could be anyone at risk who also satisfied the matching criteria and who had not had a mental health diagnosis up to the time of diagnosis of the case.

Age, marital status, ethnicity (Caucasian, Sikh, or Chinese), duration of employment, and occupational status (manager, tradesman, skilled worker, unskilled worker) while employed at a sawmill were obtained from personnel records. Statistical analyses were conducted using conditional logistic regression on Stata 8.0. Univariate models were first run with each mental health outcome and exposure variables: marital status, ethnicity, duration of employment, and occupational status. In multivariate models, marital status, ethnicity, duration of employment, and occupation were forced into the model and associations with the five categories of worker location were tested for.

For each outcome we obtained five odds ratios. The absolute sizes of these are of interest, as are the relative sizes. For example, in the case of neurotic disorders for adults, the following odds ratios were found:

Urban stay. The odds ratio is a comparison of cases with controls who have the same urban locational trajectory.
Migrate from urban. The odds ratio is a comparison of cases with controls who migrate away from the original community. Because most of these are migrations to rural places, they are in effect urban to rural migrations.
Rural stay. The odds ratio is a comparison of cases with controls who have the same rural locational trajectory.
Migrate rural to rural. The odds ratio is a comparison of cases with controls who migrate from one rural community to another.
Migrate rural to urban. The odds ratio is a comparison of cases with controls who migrate from a rural community to an urban one.

Results

Table 1 shows the number of controls and cases used in the analysis for all four mental health outcomes. Table 2 show descriptive results averaged for each mental health outcome.

Table 1	*Number of Cases and Controls for Mental Health Outcomes*	
Mental Health Outcome	**Cases**	**Controls**
Anxiety/depression	2,607	7,816
Neurotic disorder	2,102	6,306
Acute reaction to stress	1,368	4,104
Adjustment reaction	711	2,133

For all four outcomes, *urban stay* constitutes about 30% of subjects, *migrate from urban* about 10%, *rural stay* about 30%, and *migrate from rural to rural* and *migrate from rural to urban* about 15% each, with the remainder (i.e., persons with unknown migrant status) accounting for less than 2% of subjects. About one third of subjects were married. Most (about 90%) were Caucasian. Unskilled workers accounted for between 45% and 55%, on average, of cases and controls.

Table 3 shows the univariate results. Workers who remain at an urban mill have higher odds for neurotic disorder (statistically significant), adjustment reaction (statistically significant), and acute reaction to stress (not statistically significant). Workers who migrate away from an urban mill have lower odds for neurotic disorder (statistically significant), adjust-

Table 2 *Averaged Descriptive Statistics for Cases and Controls*

Variable	Cases (%)	Controls (%)
Urban stay	460 (33.6)	1,261 (30.7)
Migrate from urban	106 (7.7)	300 (7.3)
Rural stay	340 (24.9)	1,197 (29.2)
Migrate rural to urban	272 (19.9)	573 (14.3)
Migrate rural to rural	179 (13.1)	702 (17.1)
Unknown migration status	11 (0.8)	70 (1.7)
Married	421 (33.8)	1,321 (35.3)
Unmarried	826 (66.2)	2,418 (64.7)
Chinese	13 (0.9)	65 (1.6)
Sikh	108 (7.9)	229 (5.6)
Caucasian	1,247 (91.2)	3,809 (92.8)
Manager	42 (4.0)	199 (6.4)
Trades	313 (29.6)	947 (30.3)
Skilled	241 (22.8)	716 (22.9)
Unskilled	460 (43.6)	1,261 (40.4)
Average age of cases and controls	51.8 years	

ment reaction (statistically significant), and anxiety/depression (not statistically significant) and higher odds for acute reaction to stress (not statistically significant). Relative to workers who remain in an urban place, those who remain in a rural place have lower odds for all four mental health outcomes, and these are statistically significant for acute reaction to stress and adjustment reaction. In contrast, workers who migrate from a rural to an urban place have higher odds (statistically significant) for all four mental health outcomes. Finally, odds for all four mental health outcomes are lower for workers who migrate from one rural place to another. These lowered odds are statistically significant for neurotic disorder, adjustment reaction, and anxiety/depression.

Multivariate results (Table 4) illustrate that, after controlling for marital status, ethnicity, occupational status, and duration of employment, workers who migrate away from an urban mill have lower odds for neurotic disorder (statistically significant), adjustment reaction (statistically significant), and anxiety/depression, and higher odds for acute reaction to stress. Relative to workers who remain in an urban place, those who remain in a rural place have lower odds for neurotic disorder, acute reac-

Table 3 *Univariate Analyses: Odds Ratios for Four Mental Health Diagnoses Among Sawmill Workers, 1994–2001*

Location	Mental Health Diagnosis			
	Neurotic disorder ICD9 = 300 (*n* = 6,306)	Acute reaction to stress ICD9 = 308 (*n* = 4,104)	Adjustment reaction ICD9 = 309 (*n* = 2,133)	Anxiety/ depression ICD9 = 311 (*n* = 7,816)
Urban stay	1.14 (1.02, 1.27)	1.04 (.84, 1.29)	1.42 (1.08, 1.87)	.99 (.85, 1.15)
Migrate from urban	.67 (.48, .93)	1.19 (.82, 1.72)	.82 (.48, 1.38)	.94 (.73, 1.21)
Rural stay	.94 (.79, 1.11)	.68 (.54, .86)	.74 (.55, .99)	1.04 (.89, 1.21)
Migrate rural to urban	1.58 (1.28, 1.94)	1.69 (1.30, 2.19)	1.54 (1.11, 2.13)	1.30 (1.09, 1.56)
Migrate rural to rural	.75 (.60, .94)	.86 (.66, 1.11)	.63 (.44, .99)	.77 (.63, .92)

Note: Figures in parentheses are 95% confidence intervals.

Aleck Ostry, Stefania Maggi, Ruth Hershler, Lisa Chen, Clyde Hertzman

Table 4 *Multivariate Analyses: Odds Ratios Among Sawmill Workers, 1994–2001*

	Mental Health Diagnosis			
	Neurotic disorder ICD9 = 300 (*n* = 6,306)	Acute reaction to stress ICD9 = 308 (*n* = 4,104)	Adjustment reaction ICD9 = 309 (*n* = 2,133)	Anxiety/ depression ICD9 = 311 (*n* = 7,816)
Duration of job at sawmill (years)	.99 (.98, 1.01)	.99 (.98, 1.01)	.97 (.95, .99)	1.00 (.98, 1.01)
Marital status	1.00 (1.00, 1.00)	.98 (.97, 1.02)	.97 (.96, 1.01)	1.00 (100, 1.00)
Manager	1	1	1	1
Tradesman	1.09 (.72, 1.65)	1.28 (.72, 2.25)	.76 (.38, 1.50)	1.06 (.74, 1.53)
Skilled worker	1.30 (.85, 2.00)	1.05 (.58, 1.88)	1.25 (.62, 2.49)	1.24 (.85, 1.79)
Unskilled worker	1.09 (.73, 1.63)	1.24 (.71, 2.17)	1.34 (.70, 2.54)	1.18 (.83, 1.69)
Caucasian	1	1	1	1
Chinese	.71 (.32, 1.56)	.56 (.21, 1.48)	.40 (.11, 1.41)	.20 (.06, .63)
Sikh	1.28 (.94, 1.75)	1.39 (.93, 2.09)	1.08 (.64, 1.82)	1.28 (.99, 1.68)
Urban stay	1	1	1	1
Urban migrate	.64 (.45, .92)	1.11 (.74, 1.65)	.56 (.32, .99)	.92 (.70, 1.22)
Rural stay	.90 (.73, 1.12)	.74 (.56, .98)	.71 (.50, 1.01)	1.03 (.86, 1.25)
Rural to urban	1.38 (1.08, 1.77)	1.50 (1.11, 2.03)	.97 (.65, 1.45)	1.22 (.98, 1.52)
Rural to rural	.75 (.58, .97)	.86 (.63, 1.16)	.48 (.31, .72)	.80 (.64, 1.00)
Unknown migration status[a]	.62 (.18, 2.18)	1.23 (.47, 3.27)	.79 (.15, 4.23)	1.02 (.37, 2.80)

[a] Most of these workers likely left British Columbia and so were lost to follow–up.
Note: Figures in parentheses are 95% confidence intervals.

tion to stress, and adjustment reaction. Odds are higher for anxiety/ depression. Statistically significant lower odds for rural stayers were found only in the case of acute reaction to stress. Workers who migrated from a rural mill to an urban place had elevated odds for neurotic disorder, acute reaction to stress, and anxiety/depression (statistically significant). In contrast, workers who migrated from a rural mill to another rural place had lower odds for all four outcomes (statically significant for neurotic disorder, adjustment reaction, and anxiety/depression).

Discussion

The main findings of this investigation are that after controlling for socio-economic confounders, (1) workers who migrate from their original rural place to another rural place have lower odds for neurotic disorder, adjustment reaction, and anxiety/depression than workers who remain in their original urban location; (2) workers who migrate from their original rural place to an urban location have elevated odds for neurotic disorder and acute reaction to stress; (3) workers who migrate from their original urban place (most of these workers migrated to a rural place) have reduced odds for neurotic disorder and adjustment reaction; (4) workers who remain in their original rural location have lower odds for adjustment reaction compared to workers who remain in an urban location; and (5) the results differ depending on the particular mental health outcome investigated.

Several large and well-conducted Canadian studies have observed higher odds for depression among urban compared to rural residents (Kovess et al., 1987; Parikh, Wasylenki, Goering, & Wong, 1996; Wang, 2004). These observations are in accord with those of most studies of rural/urban differences in depression conducted in other countries (Fiona et al., 2002; Peen et al., 2010). Similarly, our results suggest that, for depression, there are no statistically significant differences between rural and urban residents or migrants.

However, unlike other Canadian studies, we present results for three objectively determined diagnoses other than depression (i.e., neurotic disorder, acute stress reaction, and adjustment reaction). These results indicate, especially in the case of neurotic disorder, large and statistically significant differences by location and migration status. For example, the odds for neurotic disorder among workers who migrate from a rural to an urban place were 1.38, and the odds for this same disorder were 0.75 for workers migrating from one rural place to another. These results indicate the importance of investigating mental health outcomes other than depression when exploring differences in mental health across the rural/urban continuum.

Aleck Ostry, Stefania Maggi, Ruth Hershler, Lisa Chen, Clyde Hertzman

There were several limitations to this study. Outcomes were based on ICD9 codes, which were in turn based on visits to physicians' offices and hospitalizations. In other words, outcomes were for mental health cases severe enough to require a visit to a physician or a hospital admission. Thus, this was a study of serious mental illness, as we did not use outcomes most often utilized in these types of study such as self-reported mental health. This limits the comparability of the results with those of other studies of rural/urban mental health, most of which are focused on less severe outcomes. Another limitation is that the study was based on males only. Also, as it was based on a special population of workers and was therefore not representative of the general population, the findings cannot be generalized. The definition of rural used in this investigation is very broad; rural place was defined simply as any population centre with less than 100,000 people. So, in effect, we were measuring the difference between residents of Census Metropolitan Areas and those living "elsewhere." This threshold for rurality is much higher than that used in most studies of differences in mental health across the urban/rural continuum, further limiting the comparability of the findings. Finally, our classification of workers' locational trajectories was crude. In particular, we did not divide urban migrators into those who migrate to other urban places and those who migrate from urban to rural places. However, despite these limitations the study had a great many strengths.

The study was rigorous. We used objective outcomes for serious mental illness, controlled for socio-economic differences among participants, and employed a nested case control design. Furthermore, it was conducted among current and former sawmill workers with similar work cultures, incomes, and backgrounds; observed differences in mental health outcomes by rural/urban location or by migration are less likely to be confounded than if the study had been conducted among a less homogeneous population. Because the study was based on a population originally selected on the basis of its active employment status, it largely excluded unhealthy participants. This means that people with serious organic mental health conditions were less likely to be selected into the cohort than would be the case with a less rigorously designed study; outcomes measured are likely to have arisen during the course of employment or post-employment and are likely attributable to changed environmental conditions related to location and migration. Finally, as noted by most researchers on the rural/urban health divide, in studies of this type it is important to not only measure mental health outcomes among rural and urban residents but also to assess the effects of migration between rural and urban places. This study did exactly that, and because it also ascertained migration status and location prior to diagnosis of a

mental health condition, it is unlikely that the diagnosis influenced either location or migration.

One of the implications of the findings is the need for research using outcomes other than depression. Many studies, both internationally and in Canada, indicate fairly consistently that while urbanites have higher rates of depression than their rural counterparts, the differences are often not statistically significant. If our study had focused on depression only, the results would have been similar. However, by expanding the investigation to other mental health diagnoses we were able to obtain a more complex picture of rural/urban differences in mental health. Because our study obtained results for depression similar to those of other studies, was conducted with a very homogeneous population, and was well controlled for SES, confounding our statistically significant results for neurotic disorder, adjustment reaction, and acute reaction for stress across the rural/urban continuum indicates the importance of expanding the study of mental health and rural/urban differences beyond the current focus on depression.

References

Ayuso-Mateos, J. L., Vazquez-Barquero, J. L., Dowrick, C., Lehtinen, V., Dalgard, O. S., & Casey, P. (2001). Depressive disorders in Europe: Prevalence figures from the ODIN study. *British Journal of Psychiatry, 179,* 308–316.

Bijl, R. V., Ravalli, A., & van Zessen, G. (1998). Prevalence of psychiatric disorder in the general population: Results of the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Social Psychiatry and Psychiatric Epidemiology, 33,* 587–595.

Blazer, D., George, L. K., Landerman, R., Pennybacker, M., Melville, M., & Woodbury, M. (1985). Psychiatric disorders: A rural/urban comparison. *Archives of General Psychiatry, 42,* 651–656.

Bourdon, K. H., Donald, S. R., Locke, B. Z., Narrow, W. E., & Regier, D. A. (1992). Estimating the prevalence of mental disorders in US adults from the Epidemiologic Catchment Area Study. *Public Health Reports, 107,* 663–668.

Brown, G. W., & Prudo, R. (1981). Psychiatric disorder in a rural and an urban population: 1. Aetiology of depression. *Psychological Medicine, 11,* 581–599.

Canadian Institute for Health Information. (2006). *How healthy are rural Canadians? An assessment of their health status and health determinants.* Ottawa: Author.

Comstock, G. W., & Helsing, K. J. (1976). Symptoms of depression in two communities. *Psychological Medicine, 6,* 551–563.

Dohrenwend, B. P., & Dohrenwend, B. S. (1974). Psychiatric disorders in urban settings. In G. Caplan (Ed.), *American handbook of psychiatry.* Vol. 2: *Child and adolescent psychiatry, sociocultural and community psychiatry* (pp. 424–449). New York: Basic Books.

Fiona, K., Judd, H. J., Jackson, A. K., Greg, M., Hodgins, G., & Fraser, C. (2002). High prevalence disorders in rural and urban communities. *Australia/New Zealand Journal of Psychiatry, 36*(1), 104–113.

Fischer, C. S. (1976). *The urban experience.* New York: Harcourt Brace Jovanovich.

Gaviria, F. M., Richman, J., Flaherty, J. A., Wintrob, R. M., Martinez, H., & Pacheco, C. G. (1986). Migration and mental health in Peruvian society: Toward a psychosocial model. *Social Psychiatry, 21,* 193–199.

Harpham, T. (1994). Urbanization and mental health in developing countries: A research role for social scientists, public health professionals and social psychiatry. *Social Science and Medicine, 39*(2), 233–245.

Hertzman, C., Teschke, K., Ostry, A., Hershler, R., Dimich-Ward, H., Kelly, S., et al. (1997). Cancer incidence and mortality in sawmill workers exposed to chlorophenols. *American Journal of Public Health, 87*(1), 71–79.

Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., & Eshleman, S. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. *Archives of General Psychiatry, 51,* 8–19.

Kovess, V., Murphy, H. B. M., & Tousignant, M. (1987). Urban-rural comparisons of depressive disorders in French Canada. *Journal of Nervous and Mental Diseases, 175*(8), 457–465.

Kovess-Masféty, V., Alonso, J., de Graaf, R., Demyttenaere, K., & the ESEMeD 2000 Investigators. (2005). A European approach to rural-urban differences in mental health: The ESEMeD 2000 Comparative Study. *Canadian Journal of Psychiatry, 50*(14), 926–936.

Leighton, A. H. (1959). *My name is legion: Foundations for a theory of man in relation to culture,* Vol. 1. New York: Basic Books.

Leighton, D. C., Harding, J. S., Macklin, D. B., Macmillan, A. M., & Leighton, A. H. (1963). *The character of danger: Psychiatric symptoms in selected communities,* Vol. 3. New York: Basic Books.

Lewis, G., & Booth, M. (1994). Are cities bad for your mental health? *Psychological Medicine, 24,* 913–915.

Marsella, A. (1998). Urbanization, mental health, and social deviancy: A review of issues and research. *American Psychologist, 53*(6), 624–634.

McGuffin, P., Katz, R., Aldrich, J., & Bebbington, P. (1988). The Camberwell Collaborative Depression Study. II: Investigation of family members. *British Journal of Psychiatry, 152,* 766–774.

Mueller, D. P. (1981). The current status of urban-rural differences in psychiatric disorder: An emerging trend for depression. *Journal of Nervous and Mental Disease, 169*(1), 18–27.

National Center for Health Statistics. (1970). Selected symptoms of psychological distress. *Vital and Health Statistics Series, 11*(37), 1–42.

Neff, J. A. (1983). Urbanicity and depression reconsidered: The evidence regarding depressive symptomatology. *Journal of Nervous and Mental Disease, 171*(9), 546–552.

Parikh, S. V., Wasylenki, D., Goering, P., & Wong, J. (1996). Mood disorders: Rural/urban differences in prevalence, health care utilization, and disability in Ontario. *Journal of Affective Disorders, 38,* 57–65.

Patten, S. B., Wang, J., Beck, C. A., & Maxwell, C. J. (2005). Measurement issues related to the evaluation and monitoring of major depression prevalence in Canada. *Chronic Diseases in Canada, 26*(4), 100–106.

Paykel, E. S., Abbott, R., Jenkins, R., Brugha, T. S., & Meltzer, H. (2000). Urban-rural mental health differences in Great Britain: Findings from the National Morbidity Survey. *Psychological Medicine, 30,* 269–280.

Peen, J., Schoevers, R. A., Beekman, A. T., & Dekker, J. (2010). The current status of urban-rural differences in psychiatric disorders. *Acta Psychiatrica Scandinavica, 121,* 84–93.

Plomin, R., Lichtenstein, P., Pedersen, N. L., McClearn, E. G., & Nesselroade, J. R. (1990). Genetic influences on life events during the last half of the life span. *Psychology and Aging, 5,* 25–30.

Prudo, R., Brown, G. W., Harris, T., & Dowland, J. (1981). Psychiatric disorder in a rural and an urban population. 2. Sensitivity to loss. *Psychological Medicine, 11,* 601–616.

Regier, D. A., Narrow, W. E., Rae, D. S., Manderscheid, R. W., Locke, B. Z., & Goodwin, F. K. (1993). The de facto US mental and addictive disorders service system: Epidemiologic Catchment Area prospective 1-year prevalence rates of disorders and services. *Archives of General Psychiatry, 50,* 85–94.

Robins, L. N., Helzer, J. E., Croughan, J., & Ratcliff, K. S. (1981). National Institute of Mental Health Diagnostic Interview Schedule: Its history, characteristics, and validity. *Archives of General Psychiatry, 38,* 381–389.

Robins, L. N., Locke, B. Z., & Regier, D. A. (1991). An overview of psychiatric disorders in America. In L. N. Robins & D. A. Regier (Eds.), *Psychiatric disorders in America: The Epidemiologic Catchment Area study* (pp. 328–366). New York: Free Press.

Toffler, A. (1970). *Future shock.* New York: Bantam.

van Os, J. (2003). Can the social environment cause schizophrenia? *British Journal of Psychiatry, 182,* 291–292.

Wang, J. L. (2004). Rural-urban differences in the prevalence of major depression and association impairment. *Social Psychiatry and Psychiatric Epidemiology, 39,* 19–25.

Wirth, L. (1938). Urbanism as a way of life. *American Journal of Sociology, 44*(1), 1–24.

Acknowledgements

Aleck Ostry, MA, PhD, is Professor, Department of Geography, Faculty of Social Science, University of Victoria, British Columbia, Canada; Study Director, New Emerging Team for Health in Rural and Northern British Columbia

Aleck Ostry, Stefania Maggi, Ruth Hershler, Lisa Chen, Clyde Hertzman

(NETHRN-BC); and Canada Research Chair in the Social Determinants of Community Health. Stefania Maggi, MA, PhD, is Assistant Professor, Department of Psychology and Institute of Interdisciplinary Studies, Carleton University, Ottawa, Ontario, Canada; and Study Investigator, NETHRN-BC. Ruth Hershler, MSc, is Statistical Analyst, Department of Health Care and Epidemiology, University of British Columbia, Vancouver; and Project Database Manager, NETHRN-BC. Lisa Chen, MSc, is Statistical Analyst, Human Early Learning Partnership (HELP), Department of Health Care and Epidemiology, University of British Columbia. Clyde Hertzman, MSc, MD, is Professor, School of Population and Public Health, and Director, HELP, Department of Health Care and Epidemiology, University of British Columbia; and Study Investigator, NETHRN-BC.