DOI: 10.1111/jrh.12578

THE JOURNAL OF RURAL HEALTH

ORIGINAL ARTICLE

Functional status in rural and urban adults: The Canadian Longitudinal Study on Aging

Philip St. John MD[1] | Verena Menec PhD[2] | Robert Tate PhD[3] | Nancy Newall PhD[4] | Megan O'Connell PhD[5] | Denise Cloutier PhD[6]

[1] Department of Geriatric Medicine, University of Manitoba, Winnipeg, Manitoba, Canada

[2] Department of Community Medicine, University of Manitoba, Winnipeg, Manitoba, Canada

[3] Department of Community Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada

[4] Department of Psychology, Brandon University, Brandon, Manitoba, Canada

[5] Department of Psychology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

[6] Department of Geography, University of Victoria, Victoria, British Columbia, Canada

Correspondence
Philip St. John, Department of Geriatric Medicine, University of Manitoba, RR144-800 Sherbrook St., Winnipeg, MB R3A 1M4, Canada.
Email: pstjohn@hsc.mb.ca

Abstract

Purpose: To document the prevalence of functional impairment in middle-aged and older adults from rural regions and to determine urban-rural differences.

Methods: We have conducted a secondary analysis using data from an ongoing population-based cohort study, the Canadian Longitudinal Study on Aging (CLSA). We used a cross-sectional sample from the baseline wave of the "tracking cohort." The definition of rurality was the same as the one used in the CLSA sampling frame and based on the 2006 census. This definition includes rural areas, defined as all territory lying outside of population centers, and population centers, which collectively cover all of Canada. We grouped these into "Urban," "Peri-urban," "Mixed" (areas with both rural and urban areas), and "Rural," and compared functional status across these groups. Functional status was measured using the Older Americans Resource Survey (OARS) and categorized as not impaired versus having any functional impairment. Logistic regression models were constructed for the outcome of functional status and adjusted for covariates.

Findings: No differences were found in functional status between those living in rural, mixed, peri-urban, and urban areas in unadjusted analyses and in analyses adjusting for sociodemographic and health-related factors. There were no rural-urban differences in any of the individual items on the OARS scales.

Conclusions: We found no rural-urban differences in functional status.

KEYWORDS
aging, CLSA, functional status, OARS, rural-urban disparities

Functional status is central to the care of middle-aged and older adults.[1] It can be defined as an individual's ability to carry out basic and routine activities of daily living (ADL), and to participate in life situations.[2] Lower functional status, or functional impairment, predicts death,[3] long-term care use, hospitalization, length of hospital stay, readmission after discharge,[4–7] depressive symptoms,[8,9] and a lower level of health-related quality of life[10] in a wide variety of settings. Moreover, maintaining a high level of functional status is the primary health goal of many older adults—more important than extending life for many.[11,12] Understanding the rates of functional impairment is,

therefore, important for clinicians, health and social policy makers and planners, caregivers, and the general population.

Functional status may differ in rural and urban areas for a variety of reasons. First, the social and economic determinants of health may differ between rural and urban areas,[13] and indeed between rural areas.[14] Individuals living in rural areas generally have lower incomes, lower total wealth, and lower educational attainment.[15,16] Balanced against this may be a higher level of social cohesion and social support in rural areas.[17] These factors have been demonstrated to not only differ between rural areas, but also within them.[14] Second, previous studies have shown differences in rates of depression, mental health issues, and substance use disorders between rural and urban areas—all of which can affect functional status.[18–21] Third, there may be differential migration of those with functional impairment to areas with higher levels of social and/or medical care.[22,23] This may happen between rural and urban areas, or within rural areas—for instance, moving from a farm to a small town. Fourth, urban-rural differences have been reported in infrastructure and service delivery, noting magnified issues with transportation and providing social and health care services that are different from those facing urban populations.[24–27] These issues can affect health and healthy aging. Finally, disease incidence and prevalence may vary between rural and urban areas. Risk factors, such as a higher body mass index, unhealthy diets, and different activity levels, have been shown to result in different rates of disease.[28,29]

The study of rural health and aging is complicated. Rurality may be measured in many different ways: population density, distance to major urban centers, major economic focus, and so on. These different measures may yield different associations between rurality and health status.[24,30] Second, a rural residence may have different associations with health in different societies, or within the same society over time. For instance, rural France may have more in common with urban areas in France than rural areas in Canada. Third, rural areas are not homogeneous—there is substantial variability in economic security, economic base, and sociodemographic make-up between rural areas.[14] These limitations may have contributed to fewer epidemiological studies having been conducted in rural populations compared to urban populations.

In spite of these limitations, it is important to document the prevalence of functional impairment in rural regions, and to explore rural-urban differences in functional status in order to plan and support health and social care in rural areas. Studies examining rural-urban differences are fairly rare, and they may be influenced by the country in which they are conducted. In some countries, rural-urban disparities may be growing, but this may not be the case in all countries.[31] We, therefore, conducted a secondary analysis of the Canadian Longitudinal Study on Aging (CLSA) to determine if there are rural-urban differences in functional status in Canada.

Specifically, the objectives were:

1. To determine the prevalence of functional impairment in rural adults aged 45-85; and
2. To determine if rural residence is associated with functional impairment after accounting for the effect of potential confounding factors; and
3. To determine if the risk factors for functional impairment are different in rural versus urban populations; and
4. To determine if there are differences in specific basic ADL or instrumental activities of daily living (IADL) between rural and urban populations.

METHODS

The CLSA is a population-based cohort study, which is ongoing.[32–35] We used a cross-sectional sample from the initial survey wave of the "tracking cohort." The tracking cohort is intended to be as generalizable as possible to the Canadian population of 2008.[36] The sampling frame for the tracking cohort was complex but based on Statistics Canada geographical classifications.[37] All dwellings within the same Census dissemination area block (CB) identified as either urban or rural were grouped together. In each province, clusters of CBs were created having a fixed number of dwellings with a minimum number of people in the 75-84 and 85 and over age groups. Clusters were composed entirely of urban or rural CBs and could not cross provincial boundaries.[36] This sampling strategy ensures accurate categorization of rurality, as well as an adequate sample size for rural analyses. Excluded from the sampling frame were people residing in the 3 territories and some remote regions, or residing on federal First Nations reserves and other First Nations settlements in the provinces, as well as full-time members of the Canadian Armed Forces, individuals living in institutions, individuals holding a temporary visa or having transitional health coverage, individuals unable to respond in English or French, and individuals with cognitive impairment.

DEFINITION OF RURAL

There are numerous definitions of rurality, and the definition used can influence findings.[30] We selected the definition of rural used in the CLSA sampling frame. This definition of rural is similar to the definition used in the Canadian Community Health Survey (CCHS)[38] and the 2006 census. A detailed description is provided in the 2006 Census Guide.[39] To summarize, geographical definitions are based upon the size of the community. A census metropolitan area (CMA) or a census agglomeration (CA) is formed by one or more adjacent municipalities centered on a population center (known as the core). A CMA must have a total population of at least 100,000, of which 50,000 or more must live in the core. A CA must have a core population of at least 10,000. To be included in the CMA or CA, other adjacent municipalities must have a high degree of integration with the core, as measured by commuting flows derived from previous census place of work data.[39] The definitions of rurality and the sample size within each category are shown in Table 1. Generally, a rural area is defined as an area with less than 10,000 people. For the present analyses, we collapsed the groups into 4 categories: ***Rural*** versus ***Mixed*** (the "Postal code link to dissemination

TABLE 1 Definitions of rural and urban in the CLSA

Definition for analyses	Definition in CLSA	Sample size	Definition
Rural	Rural	4,707	The area that remains after the delineation of urban areas which have been delineated using current census population data.
Mixed	Postal code link to dissemination area	2,125	This is assigned if a postal code covers a large area and it is a mixture of urban and rural area.
Peri-urban	Urban fringe	445	All small urban areas within a CMA or CA that are not contiguous with the urban core of the CMA or CA.
Peri-urban	Urban population center outside CMA and CA	1,888	Built up areas that are not contiguous within or contiguous with the urban core of the CMA or CA.
Peri-urban	Secondary core	304	A population center within a CMA that has at least 10,000 persons and was the core of a CA that has been merged with an adjacent CMA.
Urban	Urban	11,772	A large urban area around which a CMA or a CA is delineated. The urban core must have a population (based on the previous census) of at least 50,000 persons in the case of a CMA, or at least 10,000 persons in the case of a CA.

Abbreviations: CA, census agglomeration; CLSA, Canadian Longitudinal Study on Aging; CMA, census metropolitan area.
Note: The definitions "urban fringe," "urban population center outside CMA and CA," and "secondary core" are defined as separate categories in the CLSA, but are grouped together as one category, "peri-urban," in this study.

area" variable) versus ***Peri-urban*** ("urban fringe, and secondary urban sites") versus ***Urban*** ("urban core"). These definitions allow consideration of increasing rurality across an urban-rural continuum.

MEASURE OF FUNCTIONAL STATUS

Functional status can be measured as the ability to accomplish basic ADL, such as dressing, toileting, and mobilizing; and IADL, such as the preparation of meals, shopping, financial management, medication management, and the use of transportation.[40] The Older Americans Resource Survey (OARS)[36,41–44] is the measure of functional status used in the CLSA and in many other epidemiological studies. This is a standardized, reliable, and valid measure of functional impairment.[45] It can be categorized into no functional impairment (87.9% of the unweighted sample); mild impairment (9.9% of the unweighted sample); moderate impairment (1.1% of the unweighted sample); severe impairment (0.2% of the unweighted sample); and total impairment (0.2% of the unweighted sample). In general, those with excellent/good functional status could perform all ADLs without assistance; those with mild impairment could perform all but 1-3 ADLs and could get through any single day without help. Those with moderate impairment or greater needed regular assistance with at least 4 ADLs, and may have difficulty getting through a single day unassisted. There was 0.7% of the unweighted sample with missing data on one or more items of the OARS scale, which we excluded from analyses. Since functional impairment was very rare, and even minor impairments are likely to be clinically relevant, we categorized the OARS scale as "Impairment" (any level of impairment—mild, moderate, severe, and total combined together) versus "Not impaired" (no impairment reported).

We considered several potential confounding factors and interactions in our analyses. Demographic factors were self-reported. We assigned sex into 2 categories (male vs female); education into 4 categories (less than secondary school graduation, secondary school graduation but no post-secondary education, some post-secondary education, and postsecondary degree/diploma); individual income in categories of <$20,000, $20,000-$49,999, $50,000-$99,999, $100,000-$149,999, and >$150,000 (all in Canadian dollars); living situation (alone vs not alone); marital status (categorized as never married, married/common-law, separated/divorced, and widowed); and income adequacy ("very well/adequately/with some difficulty, not very well, and totally inadequately").[46] We also considered the following self-reported chronic conditions, which have been associated with functional impairment: chronic obstructive pulmonary disease, stroke or cerebrovascular accident, ischemic heart disease, cancer (any site), osteoarthritis, and cataracts.[47] These chronic conditions are less likely to be subject to surveillance bias ascribable to differing access to health care in urban and rural areas.[48] With differential access to health care, some diseases and risk factors may be more likely to be diagnosed in areas with high health care use, and thus, the observed prevalence would be higher than in areas with lower health care use.

ANALYSIS

To account for the complex sampling design, the CLSA has calculated weights to create prevalence estimates that represent the Canadian population (inflation weights) and for estimating associations (analytic weights).[34] Analytic weights have been rescaled to sum to sample size within each province. These were provided in the CLSA data set. Analyses considered the analytic weights, while descriptive statistics considered the trimmed weights. We excluded participants for whom data were missing for any of the variables.

We conducted bivariate analyses for the outcome of functional status with each of the independent variables, using chi-square tests for all categorical variables. We constructed logistic regression models with the outcome variable of OARS (which we considered any impairment vs no impairment). We constructed a series of models beginning with adjustment for age and sex, then for sociodemographic factors, and finally with the addition of health-related factors. Per the CLSA protocol,[36] we included weighting for province of residence in all regression models. As part of regression diagnostics, we sought to determine if there were interactions between rurality and other independent variables. The Canadian Institute for Health Research also suggests ascertaining interactions between sex, gender, and factors of interest.[49] In the CLSA, only sex as a biological construct, not gender as a social construct, was included as a variable.

To determine if there were interactions between a variable of interest and rural residence, we constructed logistic regression models with the main effects for that variable and rurality, as well as the interaction term of that variable and rurality. Also, we stratified analyses based on sex to examine whether sex differentially influenced functional status in rural and urban areas. Finally, we checked models for violations of the model assumptions.

RESULTS

Baseline characteristics of the sample are shown in Table 2. Note that the sampling strategy may influence some of these results (for instance, age and sex, on which the sampling frame was stratified). The majority of those living in rural areas were married, had a post-secondary degree, had an income below $100,000, and had an adequate or lesser income adequacy.

In unadjusted analyses, we did not note significant differences in functional status between those living in rural, mixed, peri-urban, and urban areas. The results of the logistic regression models are shown in Table 3. In models considering only age and sex, those living in mixed areas had higher odds of functional impairment than those living in urban areas. Those in rural and peri-urban areas had similar odds of functional impairment. Rural/urban differences in the odds of functional impairment were not apparent in models adjusting for other sociodemographic and health-related factors. In full models, there was a small effect of rurality on functional status after adjusting for other potential confounding factors (Table 3). Older age, female sex, and lower income were all associated with higher functional impairment. All the chronic conditions were also associated with functional impairment. Those with some post-secondary education also had higher levels of functional impairment. However, education and income were closely correlated; these associations are difficult to interpret in a full model adjusting for both factors.

We also constructed logistic regression models to determine if there were interactions between rural residence and the other factors that were associated with functional impairment. We noted an interaction between sex and rural residence on the odds of functional impairment ($P = .045$). However, analyses stratified on sex showed no significant differences in functional status for females living in rural, mixed, and peri-urban areas compared to those living in urban areas (OR = 0.87 (95% CI: 0.75-1.01), OR = 0.99 (95% CI: 0.81-1.20), and OR = 1.07 (95% CI: 0.90-1.28), respectively), and for males living in rural and peri-urban areas compared to those living in urban areas (OR = 0.91 (95% CI: 0.73-1.13) and OR = 0.95 (95% CI: 0.72-1.27), respectively). Only males living in mixed areas had significantly higher odds of functional impairment than those living in urban areas (OR = 1.52 (95% CI: 1.17-1.98); $P < .01$). Therefore, we present the analyses with only the main effects. Overall, the risk factors for functional impairment appear to be similar in rural and urban participants.

Finally, we considered the individual items from the OARS. The association between rurality and each of the basic ADL items is shown in Figure 1, while the association between rurality and each of the IADL items is shown in Figure 2. There were no major rural-urban differences in any of the individual items on the OARS scales.

DISCUSSION

In this analysis, we examined rural-urban differences in a population-based epidemiological study of middle-aged and older adults, and we found that there were no rural-urban differences in functional status between those living in rural regions, mixed rural/urban regions, peri-urban regions, and urban regions. This was true for unadjusted analyses. In analyses adjusted for sociodemographic and health-related factors, we noted a slightly lower risk of functional impairment in the rural participants. We did not note differences in any individual activity of daily living.

We noted a pattern of similar risk factors for functional impairment in all areas of increasing rurality—older age, being female, low income, lower educational attainment, and chronic illness were all associated with functional impairment. We chose to investigate interactions between a rural residence and sex to be consistent with CIHR suggestions.[49] We sought to determine if there were other interactions as part of regression model diagnostics, and also to determine if risk factors for functional impairment were similar in rural and nonrural areas. This would help to determine if similar potential interventions, such as income support or education, would be useful in both rural and urban areas.

Our findings are fairly consistent with a number of other studies. In Manitoba, there were similar rates of functional impairment in rural and urban parts of the province. However, there were other differences in some of the individual ADLs.[50] A proportion of these differences may have been due to differential use of aides or assistive devices in urban versus rural areas. In contrast, in the United States, several recent studies note a higher rate of functional impairment in rural areas than urban areas,[51,52] which is not entirely explained by differential migration patterns.[23] Sage and associates also note that rural populations report higher rates of functional impairment compared with urban populations across nearly all age category, gender, and racial combinations; and that disparities in rates of functional

TABLE 2 Baseline characteristics of participants

Characteristic	Rural (n = 4,707) %	Mixed[a] (n = 2,125) %	Peri-urban (n = 2,637) %	Urban (n = 11,772) %
Male sex	47.2	45.0	47.8	49.2
Age				
44-54 years	36.5	33.8	34.8	37.3
55-64 years	31.4	33.2	34.3	30.0
65-74 years	21.5	21.1	18.0	19.2
75-89 years	10.6	12.0	12.9	13.5
Education				
Less than secondary school graduation	10.2	10.3	9.0	5.6
Secondary school graduation, no post-secondary education	15.7	14.7	14.3	11.4
Some post-secondary education	7.6	9.4	9.4	7.0
Post-secondary degree/diploma	66.1	65.5	66.8	75.6
≥ 1 required question not answered	0.3	0.1	0.5	0.5
Living alone	13.0	16.1	16.9	20.0
Marital status				
Married/common-law	80.1	78.7	76.2	70.2
Never married	6.5	5.1	5.7	9.4
Widowed	6.4	7.6	7.9	7.8
Divorced/separated	7.0	8.6	10.1	12.6
Refused to answer	0.0	0.0	0.1	0.0
Self-reported income adequacy				
Very well	45.8	44.0	44.4	49.5
Adequately	36.3	34.6	35.5	32.1
With some difficulty	6.7	8.2	6.8	6.0
Not very well	1.2	1.9	1.6	1.5
Totally inadequately	0.5	0.8	0.7	0.8
Do not know/no answer/refused	0.6	0.8	0.8	0.8
Did not complete questionnaire	9.0	9.6	10.2	9.3
Household income				
< $20,000	5.0	5.1	5.3	5.0
$20,000-$49,999	27.0	27.2	24.9	20.5
$50,000-$99,999	36.4	35.1	34.1	32.9
$100,000-$149,999	17.0	15.5	18.2	18.4
≥ $150,000	9.7	11.4	11.9	16.9
Do not know/no answer/refused	4.8	5.7	5.5	6.2
Chronic conditions				
COPD or chronic changes in lungs due to smoking	5.6	6.8	5.6	5.7
Stroke or cerebrovascular accident	1.6	1.3	2.1	1.5
Cataracts	18.6	21.6	19.8	20.3
Cancer	12.5	12.4	14.2	13.8
Heart disease	8.5	8.0	9.5	9.5
Osteoarthritis	26.0	25.9	24.6	23.7
Functional status				
No problems with ADL	91.0	88.1	88.6	89.9

(Continues)

TABLE 2 (Continued)

Characteristic	Rural (n = 4,707) %	Mixed[a] (n = 2,125) %	Peri-urban (n = 2,637) %	Urban (n = 11,772) %
Mild/moderate/severe/total impairment	8.7	11.7	10.8	9.4
Inconclusive classification	0.3	0.2	0.6	0.7

Abbreviations: ADL, activities of daily living; COPD, chronic obstructive pulmonary disease.
[a]Area with postal code linked to dissemination area, a mixture of both urban and rural.

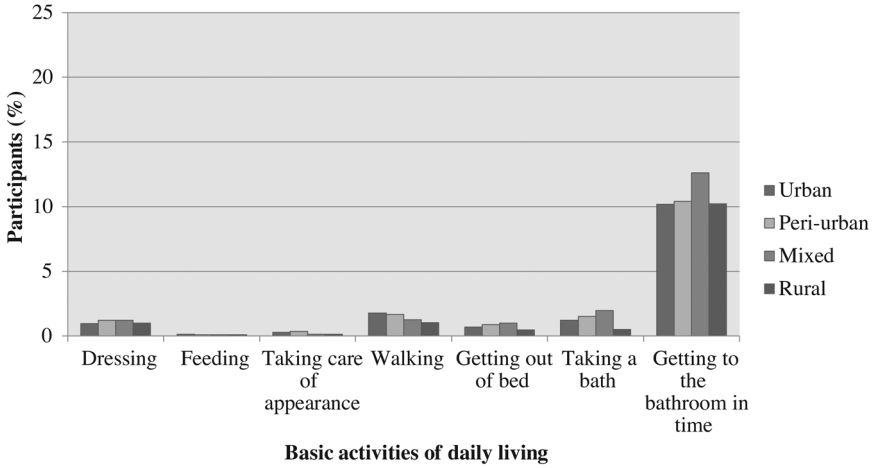

FIGURE 1 Basic activities of daily living

impairment between different categories of age, gender, and race are greater in rural areas.[53] Similar rural-urban differences have been reported in China.[54] There are fewer Canadian studies comparing functional status in rural and urban populations, although several also report lower incomes, lower educational attainment, and higher rates of negative health patterns and behaviors in rural regions.[28,29] The reasons for the differences between our findings and the findings of studies in the United States are unclear. Most of the studies in the United States considered global self-reported functional status, rather than a functional status scale that reports a score for functional impairment based on answers to a set of questions.[52] Also, Canadian rural communities have not experienced the same degree of decline in their industrial base as US rural communities, and the effect of these declines may be buffered in Canada by social and economic safety nets that permit better access to health and social care.[55,56]

There are strengths and limitations to our approach. First, we used data from a large national cohort, which is as representative of the Canadian population as possible. The measures we used were

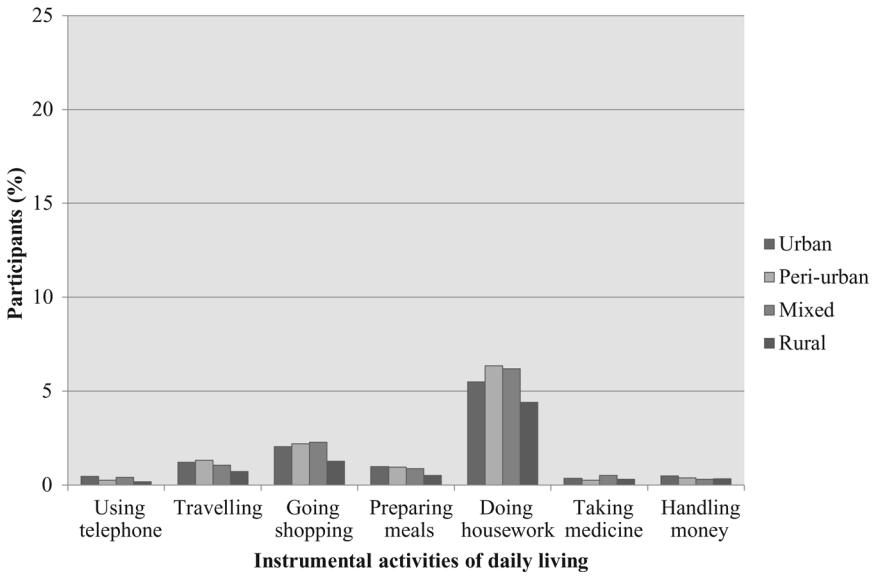

FIGURE 2 Instrumental activities of daily living

TABLE 3 Results of logistic regression models for association between rural residence and functional impairment

Variable	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Rurality (ref: urban)					
Rural	0.89 (0.79-1.01)	0.94 (0.82-1.06)	0.94 (0.82-1.07)	0.87 (0.75-1.00)*	0.87 (0.75-1.00)*
Peri-urban	1.06 (0.91-1.23)	1.04 (0.90-1.21)	1.03 (0.89-1.21)	0.96 (0.81-1.13)	0.95 (0.80-1.13)
Mixed[a]	1.16 (1.00-1.36)	1.11 (0.94-1.32)	1.10 (0.92-1.30)	1.00 (0.84-1.20)	0.99 (0.82-1.20)
Age (per year)		1.05 (1.05-1.06)**	1.05 (1.04-1.05)**	1.04 (1.03-1.04)**	1.02 (1.01-1.02)**
Sex (ref: male)		2.48 (2.23-2.76)**	2.32 (2.08-2.59)**	2.17 (1.93-2.44)**	2.12 (1.88-2.40)**
Education (ref: post-secondary degree)					
Less than secondary school graduation			1.79 (1.53-2.10)**	1.18 (1.00-1.41)	1.13 (0.95-1.34)
Secondary school graduation, no post-secondary			1.15 (0.99-1.33)	0.91 (0.78-1.06)	0.89 (0.76-1.05)
Some post-secondary education			1.47 (1.23-1.76)**	1.32 (1.08-1.60)**	1.31 (1.07-1.61)**
Marital status (ref: separated)					
Never married			1.03 (0.72-1.46)	1.16 (0.78-1.73)	1.21 (0.79-1.86)
Married/common-law			0.67 (0.48-0.94)*	1.04 (0.70-1.54)	1.12 (0.74-1.72)
Widowed			1.01 (0.72-1.41)	1.24 (0.84-1.82)	1.27 (0.84-1.93)
Divorced			0.85 (0.61-1.20)	0.91 (0.62-1.34)	0.95 (0.63-1.45)
Living arrangement (ref: 5+ people in household, excluding participant)					
Living with 0 people			0.73 (0.41-1.31)	0.67 (0.34-1.31)	0.66 (0.33-1.31)
Living with 1 people			0.75 (0.43-1.32)	0.80 (0.41-1.53)	0.78 (0.40-1.53)
Living with 2 people			0.80 (0.45-1.42)	0.91 (0.47-1.78)	0.91 (0.46-1.82)
Living with 3 people			0.76 (0.41-1.38)	0.94 (0.48-1.88)	0.95 (0.47-1.92)
Living with 4 people			0.62 (0.31-1.22)	0.71 (0.33-1.53)	0.69 (0.31-1.53)
Household income (ref: ≥ $150.000)					
< $20,000				8.21 (5.93-11.35)**	6.72 (4.84-9.33)**
$20,000-$49,999				3.57 (2.69-4.74)**	3.17 (2.38-4.22)**
$50,000-$99,999				2.01 (1.53-2.65)**	1.87 (1.41-2.47)**
$100,000-$149,999				1.35 (1.00-1.83)	1.30 (0.96-1.78)
Chronic conditions (ref: no condition)					
COPD or chronic changes in lungs due to smoking					2.24 (1.90-2.64)**
Cancer					1.18 (1.03-1.35)*
Stroke or CVA					3.60 (2.73-4.75)**
Heart disease					1.56 (1.34-1.82)**
Cataracts					1.47 (1.29-1.67)**
Osteoarthritis					2.00 (1.79-2.24)**

Abbreviations: CI, confidence interval; CVA, cerebrovascular accident; OR, odds ratio.

*P value < .05.

**P value < .01.

[a]Area with postal code linked to dissemination area, a mixture of both urban and rural.

All regression models also included province of residence and are weighted by the analytical weights.

standardized and gathered in a consistent manner across all study sites. A broad age range was considered, and the sample size was large. A limitation is the difficulty inherent in any measure of rurality, and our analyses are no different. There are numerous measures of rurality, and we considered only one measure. Second, rural regions are highly heterogeneous within a society in terms of their historical development, sociocultural and demographic make-up, degree of isolation, economic base and diversity, and regional income. These differences may be larger than rural-urban differences, and perhaps more important. With the current data available at hand, we were unable to assess these important differences. Third, there may be differential migration of those with functional impairment—perhaps toward regions with more health and social services.[22,23] In the cross-sectional data used for these analyses, we could not study this, although we hope to examine this as future waves of the CLSA become available. There may also be patterns in social and economic factors related to immigration status, religion, and community culture, which we were unable to study, and which appear to be important in the US context. Fourth, we know that there will be differential access to and use of long-term care between rural and urban areas.[57] Since the sampling frame was community-based, this may have resulted in differential sampling in rural and urban areas. However, the rates of long-term care use are low in those aged under 85, and most provinces report similar numbers of nursing home beds across regions. Fifth, while the OARS is a very valid and reliable measure of functional status, it only captures certain aspects of functional impairment.[45] There may be other measures that show more subtle differences in physical performance (such as gait speed or grip strength), which we were unable to study. Finally, we were unable to study the effect of functional impairment on an individual level in rural and urban areas. Given the difficulties in travel and access to services, this effect may be greater in rural areas. Or perhaps higher rates of social cohesion in rural areas may mitigate the effects.[17]

In spite of these limitations, we feel that our findings are important. First, our findings reflect differences in a Canadian context compared with recent US studies, which reported higher rates of functional impairment in rural populations compared to urban populations.[51,52] Consequently, rural-urban differences may depend more on the setting in which the study was conducted. Economic downturns, which affected rural regions in the United States, were less severe in rural Canada. The health effects observed may also have a lag time effect, and the CLSA sampling time frame may have been too soon after the downturns to note an effect. Perhaps, there has also not been the same degree of social change in response to economic decline in rural Canada as in the rural US. Second, our findings suggest areas for potential interventions to lessen the rates of functional impairment in both rural and urban areas. For example, we noted a very strong association between measures of social position, including income status and income adequacy, and functional impairment. Enhancing access to high-quality education, and targeted support for those with lower incomes, may be important interventions to reduce the rates of functional impairment in both rural and urban areas. Finally, our results provide data on the prevalence of functional impairment, as well as the prevalence of challenges with specific basic and IADL that reflect levels of impairment. These data can be used to support improved planning and decision making around social and medical care to rural populations.

ACKNOWLEDGMENTS

This research was made possible using the data collected by the Canadian Longitudinal Study on Aging (CLSA). Funding for the Canadian Longitudinal Study on Aging (CLSA) is provided by the Government of Canada through the Canadian Institutes of Health Research (CIHR) under grant reference: LSA 94473 and the Canada Foundation for Innovation. This research has been conducted using the CLSA dataset CLSA Baseline Tracking Dataset 3.4, under Application Number 19CA010. The CLSA is led by Drs. Parminder Raina, Christina Wolfson, and Susan Kirkland. We thank all participants of the CLSA.

DATA AVAILABILITY STATEMENT

Data are available from the Canadian Longitudinal Study on Aging (www.clsa-elcv.ca) for researchers who meet the criteria for access to deidentified CLSA data.

DISCLOSURES

The authors declare that there is no conflict of interest.

FUNDING

The contents of this study were developed under a Catalyst Grant (50240) from the Canadian Institutes of Health Research (CIHR). The opinions expressed in this manuscript are the author's own and do not reflect the views of the Canadian Longitudinal Study on Aging or the CIHR.

ORCID

Philip St. John MD https://orcid.org/0000-0002-8827-8220

REFERENCES

1. Peron EP, Gray SL, Hanlon JT. Medication use and functional status decline in older adults: a narrative review. *Am J Geriatr Pharmacother*. 2011;9(6):378-391.
2. National Committee on Vital and Health Statistics (NCVHS). Classifying and Reporting Functional Status. 2001. https://www.ncvhs.hhs.gov. Accessed March 21, 2021.
3. Cooper R, Kuh D, Hardy R. Mortality Review Group. Objectively measured physical capability levels and mortality: systematic review and meta-analysis. *BMJ*. 2010;341:c4467.
4. Depalma G, Xu H, Covinsky KE, et al. Hospital readmission among older adults who return home with unmet need for ADL disability. *Gerontologist*. 2013;53(3):454-461.
5. Greysen SR, Stijacic Cenzer I, Auerbach AD, Covinsky KE. Functional impairment and hospital readmission in medicare seniors. *JAMA Intern Med*. 2015;175(4):559-565.
6. Luppa M, Luck T, Weyerer S, König HH, Brähler E, Riedel-Heller SG. Prediction of institutionalization in the elderly. A systematic review. *Age Ageing*. 2010;39(1):31-38.
7. Shih S, Gerrard P, Goldstein R, et al. Functional status outperforms comorbidities in predicting acute care readmissions in medically complex patients. *J Gen Intern Med*. 2015;30(11):1688-1695.
8. St. John PD, Blandford AA, Strain LA. Depressive symptoms among older adults in urban and rural areas. *Int J Geriatr Psychiatry*. 2006;21(12):1175-1180.

9. Vanková H, Holmerová I, Andel R, Veleta P, Janecková H. Functional status and depressive symptoms among older adults from residential care facilities in the Czech Republic. *Int J Geriatr Psychiatry*. 2008;23(5):466-471.
10. Barile JP, Thompson WW, Zack MM, Krahn GL, Horner-Johnson W, Haffer SC. Activities of daily living, chronic medical conditions, and health-related quality of life in older adults. *J Ambul Care Manage*. 2012;35(4):292-303.
11. Fried TR, McGraw S, Agostini JV, Tinetti ME. Views of older persons with multiple morbidities on competing outcomes and clinical decision-making. *J Am Geriatr Soc*. 2008;56(10):1839-1844.
12. Fried TR, Tinetti M, Agostini J, Iannone L, Towle V. Health outcome prioritization to elicit preferences of older persons with multiple health conditions. *Patient Educ Couns*. 2011;83(2):278-282.
13. Vafaei A, Rosenberg MW, Pickett W. Relationships between income inequality and health: a study on rural and urban regions of Canada. *Rural Remote Health*. 2010;10(2):1430.
14. Lavergne MR, Kephart G. Examining variations in health within rural Canada. *Rural Remote Health*. 2012;12:1848.
15. Alasia A, Rothwell N. *The Rural/Urban Divide is Not Changing: Income Disparities Persist*. Rural and Small Town Canada Analysis Bulletin. 2003.
16. Singh V. *The Rural-Urban Income Gap within Provinces: An Update to 2000*. Rural and Small Town Canada Analysis Bulletin. 2004.
17. Keating N. *Rural Ageing: A Good Place to Grow Old?*. Bristol: Policy Press; 2008.
18. St. John PD, Blandford AA, Strain LA. Does a rural residence predict the development of depressive symptoms in older adults? *Can J Rural Med*. 2009;14(4):150-156.
19. Romans S, Cohen M, Forte T. Rates of depression and anxiety in urban and rural Canada. *Soc Psychiatry Psychiatr Epidemiol*. 2011;46(7):567-575.
20. Probst JC, Laditka SB, Moore CG, Harun N, Powell MP, Baxley EG. Rural-urban differences in depression prevalence: implications for family medicine. *Fam Med*. 2006;38(9):653-660.
21. Purtle J, Nelson KL, Yang Y, Langellier B, Stankov I, Diez Roux AV. Urban-rural differences in older adult depression: a systematic review and meta-analysis of comparative studies. *Am J Prev Med*. 2019;56(4):603-613.
22. Rothwell N, Bollman RD, Tremblay J, Marshall J. *Migration to and from Rural and Small Town Canada*. Rural and Small Town Canada Analysis Bulletin. 2002.
23. Von Reichert C, Berry EH. Rural-urban patterns of disability: the role of migration. *Popul Space Place*. 2019;26:e2271.
24. Menec VH, Nowicki S. Examining the relationship between communities' 'age-friendliness' and life satisfaction and self-perceived health in rural Manitoba, Canada. *Rural Remote Health*. 2014;14:2594.
25. Federal P. Territorial ministers responsible for seniors. *Age-Friendly Rural and Remote Communities: A Guide*. Ottawa: Minister of Industry; 2007.
26. Ryser L, Halseth G. Resolving mobility constraints impeding rural seniors' access to regionalized services. *J Aging Soc Polic*. 2012;24(3):328-344.
27. Hanlon N, Halseth G. The greying of resource communities in northern British Columbia: implications for health care delivery in already-underserviced communities. *Can Geogr*. 2005;49(1):1-24.
28. Keating N, Swindle J, Fletcher S. Aging in rural Canada: a retrospective and review. *Can J Aging*. 2011;30(3):323-338.
29. DesMeules M, Pong R, Lagacé C, et al. How healthy are rural canadians? *An Assessment of Their Health Status and Health Determinants*. Ottawa, ON: Canadian Institute for Health Information; 2006.
30. Du Plessis V, Beshiri R, Bollman RD, Clemenson HA. Definitions of Rural. *Rural and Small Town Canada Analysis Bulletin*. Ottawa, ON: Statistics Canada; 2001.
31. United Nations. *Urbanization: Expanding Opportunities but Deeper Divides. UNDESA World Social Report* 2020. New York: United Nations; 2020.
32. Raina P, Wolfson C, Kirkland S, et al. Cohort profile: the Canadian Longitudinal Study on Aging (CLSA). *Int J Epidemiol*. 2019;48(6):1752-1753j.
33. Raina PS, Wolfson C, Kirkland SA, et al. The Canadian Longitudinal Study on Aging (CLSA). *Can J Aging*. 2009;28(3):221-229.
34. Raina PS, Wolfson C, Kirkland SA, Griffith LE. The Canadian Longitudinal Study on Aging (CLSA): Report on Health and Aging in Canada - Findings from Baseline Data Collection 2010–2015. 2018. https://www.clsa-elcv.ca/stay-informed/new-clsa/2018/canadian-longitudinal-study-aging-releases-first-report-health-and-aging. Accessed March 21, 2021.
35. Kirkland SA, Griffith LE, Menec VH, et al. Mining a unique Canadian resource: the Canadian Longitudinal Study on Aging. *Can J Aging*. 2015;34(3):366-377.
36. Raina PS, Wolfson C, Kirkland SA. Canadian Longitudinal Study on Aging (CLSA) Protocol. 2008. https://www.clsa-elcv.ca/researchers. Accessed March 21, 2021.
37. Wolfson C, Raina PS, Kirkland SA, et al. The Canadian Community Health Survey as a potential recruitment vehicle for the Canadian Longitudinal Study on Aging. *Can J Aging*. 2009;28(3):243-249.
38. Statistics Canada. *Canadian Community Health Survey (CCHS): Annual Component, 2009–2010; Common Content; Derived Variable (DV) Specifications*. Ottawa, ON: Statistics Canada; 2009.
39. Statistics Canada. *2006 Census Dictionary*. Ottawa, ON: Minister of Industry; 2010.
40. National Institutes of Health. *Geriatric Assessment Methods for Clinical Decision Making*. NIH Consensus Statement Online; 1987.
41. Fillenbaum GG. Multidimensional Functional Assessment of Older Adults. *The Duke Older Americans Resources and Services Procedures*. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
42. Fillenbaum GG, Smyer MA. The development, validity, and reliability of the OARS multidimensional functional assessment questionnaire. *J Gerontol*. 1981;36(4):428-434.
43. Canadian Longitudinal Study on Aging. Basic Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) Questionnaire (Baseline) adapted from Fillenbaum, G. G. *Multidimensional Functional Assessment of Older Adults: The Duke Older American Resource and Services Procedures*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.; 1988.
44. Fillenbaum GG. Screening the elderly. A brief instrumental activities of daily living measure. *J Am Geriatr Soc*. 1985;33(10):698-706.
45. McDowell I. *Measuring Health: A Guide to Rating Scales and Questionnaires*. Oxford University Press; 2006.
46. Canadian Longitudinal Study on Aging. Socio-Demographic Characteristics Questionnaire (Baseline) adapted from Statistics Canada. Canadian Community Health Survey (CCHS) 4.2 on Healthy Aging. 2020-02-19. https://www.clsa-elcv.ca/researchers/data-collection. Accessed March 21, 2021.
47. Canadian Longitudinal Study on Aging. Chronic Conditions Tracking Questionnaire (Baseline). https://www.clsa-elcv.ca/researchers/data-collection. Accessed March 21, 2021.
48. Haut ER, Pronovost PJ. Surveillance bias in outcomes reporting. *JAMA*. 2011;305(23):2462-2463.
49. Canadian Institutes of Health Research. Sex, Gender and Health Research. https://cihr-irsc.gc.ca/e/50833.html. Accessed November 27, 2020.
50. St John PD, Havens B, Van Ineveld CHM, Finlayson M. Rural-urban differences in health status of elderly Manitobans. *Can J Rural Med*. 2002;7(2):89-93.
51. Centers for Disease Control and Prevention. Prevalence of Disability and Disability Types by Urban-Rural County Classification – United

States. 2016. https://www.cdc.gov/ncbddd/disabilityandhealth/features/disability-prevalence-rural-urban.html. Accessed February 19, 2020.
52. Zhao G, Okoro CA, Hsia J, Garvin WS, Town M. Prevalence of disability and disability types by urban-rural county classification — U.S., 2016. *Am J Prev Med*. 2019;57(6):749-756.
53. Sage R, Ward B, Myers A, Ravesloot C. Transitory and enduring disability among urban and rural people. *J Rural Health*. 2019;35(4):460-470.
54. Peng X, Song S, Sullivan S, Qiu J, Wang W. Ageing, the urban-rural gap and disability trends: 19 years of experience in China — 1987 to 2006 (disability trends in China). *PLoS One*. 2010;5(8):e12129.
55. Thiede BC, Monnat SM. The great recession and America's geography of unemployment. *Demogr Res*. 2016;35:891-928.
56. Beshiri R. Manufacturing Employment in the Resource Sector Value Chain: A Rural-Urban Comparison for 2001 to 2008. *Rural and Small Town Canada Analysis Bulletin*. Catalogue no. 21-006-XIE. Ottawa, ON: Statistics Canada; 2010.
57. Cloutier D, Penning M, Nuernberger K. Long-term care service delivery challenges for ageing in place in rural communities. In: Skinner M, Hanlon N, eds. *Ageing Resource Communities: New Frontiers of Rural Population Change, Community Development and Voluntarism*. London: Taylor and Francis; 2015;89-102.

How to cite this article: John PSt, Menec V, Tate R, Newall N, O'Connell M, Cloutier D. Functional status in rural and urban adults: the Canadian Longitudinal Study on Aging. *J Rural Health*. 2022;38:679–688. https://doi.org/10.1111/jrh.12578