

Rural and Urban Differences in the Risk of Inflammatory Bowel Disease and Subsequent Health Services Utilization in Ontario

M. Ellen Kuenzig, Geoffrey C. Nguyen and Eric I. Benchimol

Abstract

Canada has one of the highest rates of inflammatory bowel disease (IBD) in the world, with 1 in 140 Canadians currently living with the disease. IBD occurs less often among individuals living in rural households. This protective effect is particularly pronounced in young children, and early-life exposure to the rural environment greatly reduces the risk. However, individuals living in rural areas who have IBD have decreased access to specialist gastroenterology care.

The Issue

Canada has one of the highest rates of inflammatory bowel disease (IBD) in the world (Benchimol et al. 2011; Molodecky et al. 2012; Ng et al. 2018). Currently, 1 in 140 Canadians lives with IBD, and this is expected to increase to 1 in 100 by 2030 (Coward et al. 2019; Kaplan et al. 2019). Increases seen in Canada and other developed countries over the past century are now being mirrored in newly industrialized countries that are becoming increasingly urbanized (Benchimol et al. 2011; Molodecky et al. 2012; Ng et al. 2018). A systematic review suggested that people living in urban environments were more likely to develop IBD compared to those living in rural environments; however, there was high heterogeneity in the methodology and results of studies included in the review (Soon et al. 2012).

In the setting of universal healthcare, rural–urban differences in health services utilization and outcomes have been noted, for example, in increased healthcare utilization for acute hypo- and hyperglycemic episodes in people with diabetes and in decreased cancer survival (Booth et al. 2005; Hallet et al. 2015). In a survey of rural residents of Saskatchewan, a quarter of the patients had difficulty obtaining required specialist care, and a third of the patients were required to travel >200 km to access specialist care (Karunanayake et al. 2015). Previous literature has suggested that although individuals living in rural areas may be less likely to develop IBD, they have decreased access to specialist gastroenterology care (Benchimol et al. 2018; Lange et al. 2015). For some chronic

conditions, decreased utilization of specialist care does not seem to affect outcomes (Smith et al. 2008; Vanasse et al. 2010). However, IBD patients with access to specialist care are less likely to be hospitalized, visit the emergency department or require surgery (Benchimol et al. 2016; Nguyen et al. 2011, 2019). Patients with IBD have lower rates of in-hospital mortality when they are primarily treated by a gastroenterologist (Murthy et al. 2012).

We highlight two recent multi-province studies conducted by the Canadian Gastro-Intestinal Epidemiology Consortium that evaluated rural–urban differences in the epidemiology of IBD (Benchimol et al. 2017) and health services utilization and outcomes in patients with IBD (Benchimol et al. 2018).

The Process

We conducted a population-based study using health administrative data from Ontario, Alberta, Manitoba and Nova Scotia, four Canadian provinces comprising 21.1 million people (57% of Canada’s population). We identified all incident cases of IBD in each province using previously validated algorithms (Benchimol et al. 2009, 2014; Bernstein et al. 1999; Rezaie et al. 2012). Individuals were assigned to an urban residence if they lived in a metropolitan area or a “census agglomeration influence zone” (i.e., an area outside of a metropolitan area but influenced by the metropolitan area, such as having a high proportion of its population commute to the metropolitan area for employment; du Plessis et al. 2002).

We first compared the incidence of IBD in rural and urban dwellers and assessed the influence of early-life rural household on the risk of IBD in a birth cohort. We also determined differences in health services utilization for IBD care in rural and urban patients. Emergency department visits were evaluated in Ontario only due to data availability. *IBD-specific* healthcare encounters were associated with a diagnostic code for IBD, whereas *IBD-related* encounters could include IBD-specific visits as well as visits for signs, symptoms and common extraintestinal manifestations of IBD.

We also determined the use of gastroenterologist care for IBD-specific and IBD-related care, as well as the risk of colectomy (ulcerative colitis) and intestinal resection or colectomy (Crohn’s disease), among rural and urban dwellers. The results were reported as incidence rate ratios (IRRs), hazard ratios (HRs) or odds ratios (ORs) with a 95% confidence interval (CI) and with urban residence being the reference group. All models were adjusted for age, sex and mean neighbourhood income quintile, which is a validated proxy for individual-level income (Glazier et al. 2003).

Provincial privacy laws prohibit the sharing of individual-level data across provinces. To obtain multiprovince estimates, we used a distributed network analytic approach. That is, we applied the same methods to each provincial database and combined the results in a meta-analysis. This approach enabled us to measure between-province variation in the association between living in a rural household and our outcomes of interest.

Findings

Risk of IBD

People living in rural households were significantly less likely to develop IBD (IRR: 0.90; 95% CI: 0.81, 0.99), with the effect being most pronounced among children diagnosed with IBD before 10 years of age (IRR: 0.58; 95% CI: 0.43, 0.73) and between 10 and 17.9 years (IRR: 0.72; 95% CI: 0.64, 0.81). There was a strong effect of early-life exposure to a rural environment and protection against later development of IBD in the birth cohort (IRR in children with ≥1 year of continuous rural residence from birth: 0.77; 95% CI: 0.58, 0.96). The incidence of adult-onset IBD was similar for individuals living in rural and urban

households (Figure 1). Similar findings were observed when separating subtypes of IBD, Crohn’s disease and ulcerative colitis.

Health services utilization

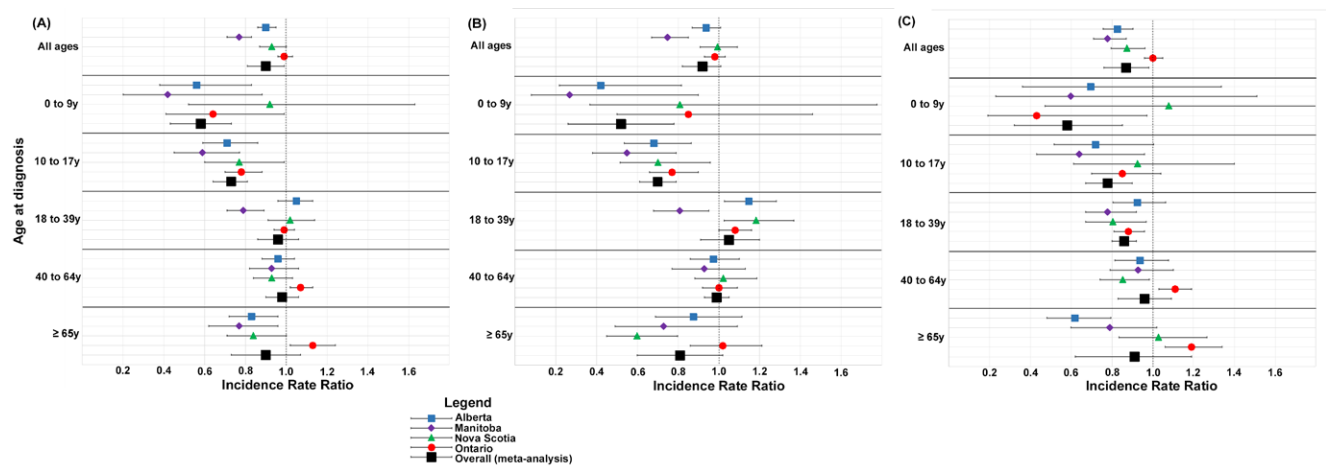
The study included 41,879 incident IBD patients. Rural and urban patients had similar numbers of out-patient visits for both IBD-specific (IRR: 0.99; 95% CI: 0.94, 1.04) and IBD-related (IRR: 0.99; 95% CI: 0.92, 1.07) reasons, with rates of out-patient visits being fairly similar between provinces. However, rural patients with IBD were hospitalized more frequently for IBD-specific (IRR: 1.17; 95% CI: 1.02, 1.34) and IBD-related (IRR: 1.27; 95% CI: 1.04, 1.56) reasons. Notably, hospitalizations were more common among patients living in rural areas of Alberta and Manitoba but not Ontario.

Rural patients in Ontario also visited the emergency department more frequently (IBD specific: IRR: 1.53; 95% CI: 1.42, 1.65; IBD related: IRR: 1.33; 95% CI: 1.25, 1.40). Accounting for specialist gastroenterology care provision did not appreciably change the associations between living in a rural household and utilizing health services (out-patient visits, emergency department visits and hospitalization) in Ontario.

Use of specialist care

Patients living in rural households were less likely to have an IBD-specific (OR: 0.46; 95% CI: 0.32, 0.65) or IBD-related (OR: 0.50; 95% CI: 0.37, 0.68) visit to a gastroenterologist – a finding that was unique to patients with adult-onset IBD and particularly pronounced among those diagnosed with IBD after 64 years of age (IBD specific: OR: 0.35; 95% CI: 0.26, 0.46; IBD related: OR: 0.39; 95% CI: 0.23, 0.64).

FIGURE 1. Incidence rate ratio for (A) IBD, (B) Crohn’s disease and (C) ulcerative colitis, based on rural–urban status at the time of diagnosis



IBD = inflammatory bowel disease.
Source: Benchimol et al. 2017.

Figure 2 depicts the proportion of IBD care provided by gastroenterologists, with higher proportions seen in urban areas of Alberta, Manitoba and Ontario.

There was notable statistical heterogeneity between provinces in the impact of rurality on use of gastroenterologist care, with I² values >95% for all age groups except those diagnosed <10 years of age. Among adults (diagnosed ≥18 years of age), the largest discrepancies in the use of specialist care for rural patients were observed in Manitoba, whereas the smallest discrepancies were seen in Alberta.

Surgery

Patients with ulcerative colitis living in rural and urban areas had a similar risk of colectomy (HR: 0.92; 95% CI: 0.79, 1.06). This was also the case for the risk of intestinal resection among patients with Crohn’s disease (HR: 0.98; 95% CI: 0.88, 1.07). However, rural patients with Crohn’s disease in Ontario were more likely to require a second intestinal resection (OR: 1.55; 95% CI: 1.16, 2.08); this same effect was not observed in Alberta and Manitoba (pooled OR: 1.21; 95% CI: 0.79, 1.63).

Implications

IBD occurs less often among individuals living in rural households. This protective effect was particularly pronounced in young children, and early-life exposure to the rural environment greatly reduced the risk. This implies that modification of early-life environmental risk factors may have the greatest impact in reducing the risk of pediatric-onset but not adult-onset IBD.

Although patients living in rural households had similar numbers of out-patient visits and hospitalizations compared to those living in urban households, rural patients were less likely to see gastroenterologists during these visits. Living in a rural household was not associated with lower use of gastroenterologist

care in children with IBD, but rural–urban disparities in the use of specialist care increased with age. Although seniors diagnosed with IBD tend to have milder disease, they are more likely to have multiple chronic conditions and are at an increased risk of malignant and infectious complications arising from IBD and its treatment. Thus, they represent a vulnerable portion of the IBD population who are at risk of the negative ramifications of poor access to specialist care. **HQ**

References

Benchimol, E.I., K.J. Fortinsky, P. Gozdyra, M. Van den Heuvel, J. Van Limbergen and A.M. Griffiths. 2011. “Epidemiology of Pediatric Inflammatory Bowel Disease: A Systematic Review of International Trends.” *Inflammatory Bowel Diseases* 17(1): 423–39. doi:10.1002/ibd.21349.

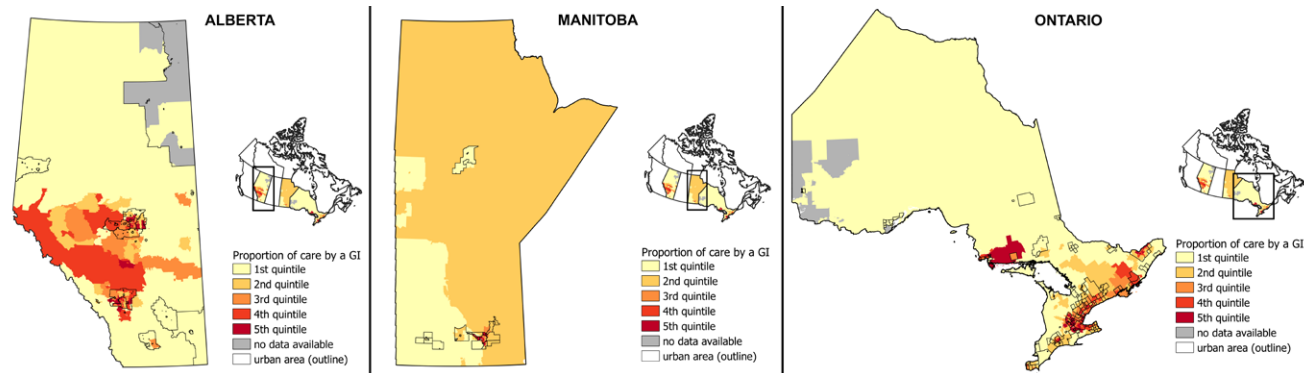
Benchimol, E.I., A. Guttman, A.M. Griffiths, L. Rabeneck, D.R. Mack, H. Brill et al. 2009. “Increasing Incidence of Paediatric Inflammatory Bowel Disease in Ontario, Canada: Evidence from Health Administrative Data.” *Gut* 58(11): 1490–97. doi:10.1136/gut.2009.188383.

Benchimol, E.I., A. Guttman, D.R. Mack, G.C. Nguyen, J.K. Marshall, J.C. Gregor et al. 2014. “Validation of International Algorithms to Identify Adults with Inflammatory Bowel Disease in Health Administrative Data from Ontario, Canada.” *Journal of Clinical Epidemiology* 67(8): 887–96. doi:10.1016/j.jclinepi.2014.02.019.

Benchimol, E.I., G.G. Kaplan, A.R. Otley, G.C. Nguyen, F.E. Underwood, A. Guttman et al. 2017. “Rural and Urban Residence During Early Life Is Associated with Risk of Inflammatory Bowel Disease: A Population-Based Inception and Birth Cohort Study.” *American Journal of Gastroenterology* 112(9): 1412–22. doi:10.1038/ajg.2017.208.

Benchimol, E.I., M.E. Kuenzig, C.N. Bernstein, G.C. Nguyen, A. Guttman, J.L. Jones et al. 2018. “Rural and Urban Disparities in the Care of Canadian Patients with Inflammatory Bowel Disease: A Population-Based Study.” *Clinical Epidemiology* 10: 1613–26. doi:10.2147/CLEP.S178056.

FIGURE 2. Heat map demonstrating that a higher proportion of IBD care provided by gastroenterologists (darker colours) was more likely to be located in urban regions (outlined boxes)



IBD = inflammatory bowel disease. Source: Benchimol et al. 2018.

- Benchimol, E.I., D.G. Manuel, N. Mojaverian, D.R. Mack, G.C. Nguyen, T. To et al. 2016. "Health Services Utilization, Specialist Care, and Time to Diagnosis with Inflammatory Bowel Disease in Immigrants to Ontario, Canada: A Population-Based Cohort Study." *Inflammatory Bowel Disease* 22(10): 2482–90. doi:10.1097/MIB.0000000000000905.
- Bernstein, C.N., J.F. Blanchard, P. Rawsthorne and A. Wajda. 1999. "Epidemiology of Crohn's Disease and Ulcerative Colitis in a Central Canadian Province: A Population-Based Study." *American Journal of Epidemiology* 149(10): 916–24.
- Booth, G.L., J.E. Hux, J. Fang and B.T.B. Chan. 2005. "Time Trends and Geographic Disparities in Acute Complications of Diabetes in Ontario, Canada." *Diabetes Care* 28(5): 1045–50.
- Coward, S., F. Clement, E.I. Benchimol, C.N. Bernstein, J.A. Avina-Zubieta, A. Bitton et al. 2019. "Past and Future Burden of Inflammatory Bowel Diseases Based on Modeling of Population-Based Data." *Gastroenterology* 156(5): 1345–53.e4. doi:10.1053/j.gastro.2019.01.002.
- du Plessis, V., R. Beshiri, R.D. Bollman and H. Clemenson. 2002. *Definitions of "Rural."* Catalogue no. 21-601-MIE2002061. Ottawa, ON: Statistics Canada. Retrieved April 30, 2019. <http://www.statcan.gc.ca/pub/21-601-m/21-601-m2002061-eng.htm>.
- Glazier, R.H., M.I. Creatore, M.M. Agha and L.S. Steele; Inner City Toronto Time Trends Working Group. 2003. "Socioeconomic Misclassification in Ontario's Health Care Registry." *Canadian Journal of Public Health* 94(2): 140–43.
- Habashi, P., S. Bouchard and G.C. Nguyen. 2018. "Transforming Access to Specialist Care for Inflammatory Bowel Disease: The PACE Telemedicine Program." *Journal of the Canadian Association of Gastroenterology*. doi:10.1093/jcag/gwy046.
- Hallet, J., C.H.L. Law, P.J. Karanicolas, R. Saskin, N. Liu and S. Singh. 2015. "Rural-Urban Disparities in Incidence and Outcomes of Neuroendocrine Tumors: A Population-Based Analysis of 6271 Cases." *Cancer* 121(13): 2214–21. doi:10.1002/cncr.29338.
- Kaplan, G.G., C.N. Bernstein, S. Coward, A. Bitton, S.K. Murthy, G.C. Nguyen et al. 2019. "The Impact of Inflammatory Bowel Disease in Canada 2018: Epidemiology." *Journal of the Canadian Association of Gastroenterology* 2(Suppl. 1): S6–S16. doi:10.1093/jcag/gwy054.
- Karunanayake, C.P., D.C. Rennie, L. Hagel, J. Lawson, B. Janzen, W. Pickett et al. 2015. "Access to Specialist Care in Rural Saskatchewan: The Saskatchewan Rural Health Study." *Healthcare (Basel)* 3(1): 84–99. doi:10.3390/healthcare3010084.
- Lange, A., A. Prenzler, O. Bachmann, R. Linder, S. Neubauer, J. Zeidler et al. 2015. "Regional Differences in Health Care of Patients with Inflammatory Bowel Disease in Germany." *Health Economics Review* 5(1): 29. doi:10.1186/s13561-015-0067-1.
- Molodecky, N.A., I.S. Soon, D.M. Rabi, W.A. Ghali, M. Ferris, G. Chernoff et al. 2012. "Increasing Incidence and Prevalence of the Inflammatory Bowel Diseases with Time, Based on Systematic Review." *Gastroenterology* 142(1): 46–54.e42. doi:10.1053/j.gastro.2011.10.001.
- Murthy, S.K., A.H. Steinhart, J. Tinmouth, P.C. Austin and G.C. Nguyen. 2012. "Impact of Gastroenterologist Care on Health Outcomes of Hospitalised Ulcerative Colitis Patients." *Gut* 61(10): 1410–16. doi:10.1136/gutjnl-2011-301978.
- Ng, S.C., H.Y. Shi, N. Hamidi, F.E. Underwood, W. Tang, E.I. Benchimol et al. 2018. "Worldwide Incidence and Prevalence of Inflammatory Bowel Disease in the 21st Century: A Systematic Review of Population-Based Studies." *Lancet* 390(10114): 2769–78. doi:10.1016/S0140-6736(17)32448-0.
- Nguyen, G.C., S. Bouchard, C. Diong; Promoting Access and Care through Centres of Excellence (PACE) Network. 2019. "Access to Specialists and Emergency Department Visits in Inflammatory Bowel Disease: A Population-Based Study." *Journal of Crohn's and Colitis* 13(3): 330–36. doi:10.1093/ecco-jcc/jjy161.
- Nguyen, G.C., Z. Nugent, S. Shaw and C.N. Bernstein. 2011. "Outcomes of Patients with Crohn's Disease Improved from 1988 to 2008 and Were Associated with Increased Specialist Care." *Gastroenterology* 141(1): 90–97. doi:10.1053/j.gastro.2011.03.050.
- Rezaie, A., H. Quan, R.N. Fedorak, R. Panaccione and R.J. Hilsden. 2012. "Development and Validation of an Administrative Case Definition for Inflammatory Bowel Diseases." *Canadian Journal of Gastroenterology* 26(10): 711–17.
- Smith, K.B., J.S. Humphreys and M.G.A. Wilson. 2008. "Addressing the Health Disadvantage of Rural Populations: How Does Epidemiological Evidence Inform Rural Health Policies and Research?" *Australian Journal of Rural Health* 16(2): 56–66. doi:10.1111/j.1440-1584.2008.00953.x.
- Soon, I.S., N.A. Molodecky, D.M. Rabi, W.A. Ghali, H.W. Barkema and G.G. Kaplan. 2012. "The Relationship Between Urban Environment and the Inflammatory Bowel Diseases: A Systematic Review and Meta-Analysis." *BMC Gastroenterology* 12: 51. doi:10.1186/1471-230X-12-51.
- Vanasse, A., J. Courteau, A.A. Cohen, M.G. Orzanco and C. Drouin. 2010. "Rural-Urban Disparities in the Management and Health Issues of Chronic Diseases in Quebec (Canada) in the Early 2000s." *Rural and Remote Health* 10(4): 1548.

About the Authors

M. Ellen Kuenzig, PhD, is a postdoctoral fellow at the Children's Hospital of Eastern Ontario (CHEO) Inflammatory Bowel Disease Centre and at ICES Ottawa. She may be contacted by e-mail at: mkuenzig@cheo.on.ca.

Geoffrey C. Nguyen, MD, PhD, FRCPC, is a gastroenterologist at the Mount Sinai Hospital Inflammatory Bowel Disease Centre, where he leads the Promoting Access to Centres of Excellence IBD Telemedicine Program. He is an associate professor with the Institute of Health Policy, Management and Evaluation at the University of Toronto and an adjunct scientist at ICES.

Eric I. Benchimol, MD, PhD, FRCPC, is a pediatric gastroenterologist at the Children's Hospital of Eastern Ontario (CHEO) Inflammatory Bowel Disease Centre, a senior scientist and director of the Health Information Technology Program at the CHEO Research Institute, a core scientist at ICES and an associate professor in the Department of Pediatrics and the School of Epidemiology and Public Health at the University of Ottawa.