National estimates of the burden of inflammatory bowel disease among racial and ethnic groups in the United States

Geoffrey C. Nguyen, Christopher A. Chong, Rachel Y. Chong

Mount Sinai Hospital Centre for Inflammatory Bowel Disease, University of Toronto, Toronto, Ontario, Canada
Institute for Health Policy Management and Evaluation, University of Toronto, Canada
Division of Gastroenterology and Hepatology, Johns Hopkins School of Medicine, USA
Department of Medicine, Lakeridge Health, Oshawa, Ontario, Canada

Received 18 July 2013; received in revised form 11 August 2013; accepted 2 September 2013

KEYWORDS:
Inflammatory bowel disease; Crohn's disease; Ulcerative colitis; Prevalence; Hospitalization; Race

Abstract

Background: The epidemiology of inflammatory bowel disease (IBD) is poorly characterized in minorities in the U.S. We sought to enumerate the burden of IBD among racial and ethnic groups using national-level data.

Methods: Data from the National Health Interview Survey was used to calculate prevalence and incidence of IBD among adults (≥18 years) in 1999. The Nationwide Inpatient Sample was queried to ascertain rates of IBD-related hospitalizations and the Underlying Cause of Death Database was accessed to quantify IBD-related mortality.

Results: An estimated 1,810,773 adult Americans were affected by IBD yielding a prevalence of 908/100,000, which was higher in Non-Hispanic Whites (1099/100,000) compared with Non-Hispanic Blacks (324/100,000), Hispanics (383/100,000), and non-Hispanic Other (314/100,000). Relative to Non-Hispanic Whites, the odds ratios for having a diagnosis of IBD associated with being Non-Hispanic Black, Hispanic, and Other Non-Hispanic race after adjusting for age, sex, and geographic region were 0.33 (95% CI: 0.19 – 0.57), 0.45 (95% CI: 0.26 – 0.77), and 0.34 (95% CI: 0.12 – 0.93), respectively. IBD incidence was similarly lower in Non-Hispanic Blacks (24.9/100,000) and Hispanics (9.9/100,000) compared to Non-Hispanic Whites (70.2/100,000). The ratio of IBD hospitalizations to prevalence was disproportionately higher among Non-Hispanic Blacks (24.9/100,000) and Hispanics (9.9/100,000) compared to Non-Hispanic Whites (70.2/100,000). The ratio of IBD-related mortality was greater in Non-Hispanic Blacks (0.061%) compared to Non-Hispanic Whites (0.036%) and Hispanics (0.026%).
1. Introduction

The prevalence of inflammatory bowel diseases (IBD) comprising Crohn's disease (CD) and ulcerative colitis (UC) appears to be rising worldwide, with the greatest prevalence and incidence in North America and Europe, while it is less common in South America, Africa, and Asia. Even in low-prevalence regions, there is emerging incidence of IBD in India and Southeast Asian countries where it was not previously described. The relative contributions of genetic and environmental factors to the geographic variation in IBD prevalence and incidence remain unclear. Moreover, it remains largely unknown whether racial and ethnic minorities in the United States share a similar burden of IBD as their white counterparts.

A series of hospital-based epidemiological studies from Baltimore in the 1960s and 1970s suggest that the incidence of IBD among Blacks increased sharply from one-fifth to three-quarters that of Non-Hispanic Whites in the time interval between the two studies. In the last study in the series, the incidence of CD among Black females actually surpassed that of Non-Hispanic White females and males. A mail survey of Kaiser Permanente health plan members suggests similar hospitalization rates between Non-Hispanic Whites and Blacks, which were much higher than that of Hispanics and Non-Hispanic Asians. In the same study, the prevalence of CD among Non-Hispanic Whites was nearly 50% higher than that of Blacks and 8- to 10-fold higher than that of Hispanics and Asians. The hospitalization-based studies in both Baltimore and California, however, likely captured only more severe IBD cases, while the prevalence study was limited by its geographic scope and absence of epidemiological data on UC.

The need to understand the nationwide burden of inflammatory bowel disease in diverse ethnic populations is underscored by the prediction that by 2050, 54% of the U.S. population will comprise minority populations, with Hispanics and Non-Hispanic Blacks, the two largest racial and ethnic groups, expected to contribute to 45% of the U.S. population. Moreover, the health of America's minority groups are threatened by disparities in healthcare access that have been described across a spectrum of chronic diseases. More robust and generalizable estimations of IBD disease burden among Hispanics and Non-Hispanic Blacks are warranted in order to properly allocate and optimize healthcare delivery. Given the dearth of IBD epidemiological data among racial and ethnic minorities, we implemented nationally derived data to characterize IBD prevalence, incidence, hospitalizations, and mortality in these under-served populations.

2. Materials and methods

2.1. Data sources

2.1.1. National Health Interview Study

Prevalence estimates were ascertained from the National Health Interview Study (NHIS) conducted in 1999, which has been previously described for health utilization and labor economic studies in IBD. The NHIS is an annual survey conducted by U.S. census bureau employees on behalf of the National Center for Health Statistics (NCHS) under the Centers for Disease Control (CDC). It comprises a cross-sectional sample of all non-institutionalized civilians in the U.S., excluding military personnel, prisoners, and residents of long-term facilities. Selected households were invited to participate in a computer-assisted interview conducted by U.S. Census personnel, and the household response rate was 87.6% in 1999. One adult (18 years and older) and one child from each household were randomly selected to answer an adult and child questionnaire, respectively, that queried information on demographics; income; healthcare access, utilization, and insurance; presence of medical and psychiatric conditions, health status and limitations; and satisfaction with health services. Race and ethnicity were self-reported in all respondents and further categorized into mutually exclusive categories: Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other. While core components of the survey were repeated each year, the supplemental component changed annually. In 1999 only, adult survey respondents were asked, "Have you EVER been told by a doctor or other health professional that you had Crohn's disease or ulcerative colitis?" Those responding affirmatively were further asked, "How old were you when you were first told you had Crohn's disease or ulcerative colitis?" and "DURING THE PAST 12 MONTHS, have you had symptoms of Crohn's disease or ulcerative colitis?" Disease duration was derived from the difference between attained age and age at diagnosis. Incident cases were defined as individuals with disease duration of 1 year or less with active IBD symptoms within the past 12 months.

2.1.2. Nationwide Inpatient Sample

Hospitalization data were extracted from the Nationwide Inpatient Sample (NIS) from 1999. The NIS is a 20% stratified sample of non-federal, acute-care hospitals in the United States and is maintained as part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality (AHRQ). Each discharge abstract includes a unique identifier, demographic variables (defined as age, gender, and race/ethnicity, median income for ZIP code), source of admission, discharge disposition,
primary and secondary diagnoses (up to 15), primary and secondary procedures (up to 15), primary insurance payers, total hospital charges, and length of stay. The NIS has been extensively used to characterize IBD hospitalizations and IBD-related health outcomes.\textsuperscript{9–13} For this study, we identified all hospital discharges in 1999 with the following criteria: 1) were 18 years or older; 2) had a principal diagnosis of inflammatory bowel disease (UC or CD) identified by the Clinical Modification of the International Classification of Diseases, 9th Revision (ICD-9-CM) code of 555.xx and 556.xx. IBD hospitalizations for less than 24 h were excluded because many of these may have been for inpatient infusions of infliximab. Hospital discharges in the states (GA, IL, ME, OR, WA) which did not collect race and ethnicity data were also excluded. Major abdominal surgery (i.e., bowel resection) undertaken during a hospitalization for IBD was identified using ICD-9-CM procedural codes as previously described.\textsuperscript{9,10}

2.1.3. Underlying Cause of Death database
Deaths caused by CD or UC in 1999 were identified through the Underlying Cause of Death database spanning from 1999 to 2010. These mortality data are derived from death certificates from the fifty states and the District of Columbia and reported to the National Center for Health Statistics through the Vital Statistics Cooperative Program. The database contains demographic information (age, sex, ethnicity, race, state residence) and primary cause of death. We identified IBD-related deaths using ICD-10 codes for IBD (K50.x and K51.x). Ethnicity- and race-specific death rates due to IBD were calculated by accessing the CDC WONDER Online Database, released 2012 on Mar 9, 2013 at \url{http://wonder.cdc.gov/ucd-icd10.html}.

2.2. Statistical analyses

Data were analyzed using the Stata 10.0 SE software package (Stata Corp LP, College Station, Texas). Because of the complex two-stage sampling design of NHIS data, we used Stata's SVY command to take into account individual sampling weights for variance estimation. Point prevalence for IBD was calculated by estimating from the NHIS sample, the total number diagnoses of IBD in the US divided by the total number of adult non-institutionalized citizens in the US. Sex-specific and region-specific point prevalence of IBD was calculated. Estimates for IBD point prevalence and their 95% confidence intervals were calculated for the following mutually exclusive racial/ethnic groups: Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other. Similarly, incidence was calculated by dividing new cases of IBD diagnosed within 1 year by individuals at risk for IBD, which was the US Census population minus prevalent cases of IBD. Descriptive statistics were performed to compare other clinical factors among racial groups. Using NIS data, race-specific rates of IBD hospitalization were calculated by dividing the national estimate of IBD hospitalizations for each racial/ethnic group by the 1999 U.S. census population for that respective racial group, excluding the weighted contribution of states which did not collect racial data in the NIS. The rate of IBD-related surgery was similarly calculated by estimating the national counts of IBD-related surgery within each racial/ethnic group by the respective US Census population.

To determine whether the rates of IBD-related hospitalizations, surgeries, and deaths were proportional to the prevalence of IBD in each racial/ethnic group, we calculated the ratio of race-specific hospitalization rates, surgery rates, and death rates to the point prevalence of IBD for each respective racial/ethnic group.

Survey-based multiple logistic regression was to determine the association between IBD diagnosis and race/ethnicity while adjusting for age, sex, and geographic region.

2.3. Ethical considerations

The NHIS and NIS are publically accessible datasets and contain completely de-identified data, and the Underlying Cause of Death database reported data only in aggregate. Thus, use of this database was exempt from research ethics approval consistent with the policies at the Johns Hopkins Medical Institutions (Baltimore) and Mount Sinai Hospital (Toronto).

3. Results

3.1. Prevalence and incidence

There were 271 individuals among the 30,801 adult respondents who reported having either UC or CD, yielding a nationwide IBD prevalence of 908 per 100,000 (95% CI: 798 – 1033 per 100,000). There were an estimated 1,810,773 adults in the United States with IBD in 1999. Sex-specific prevalence of IBD was greater among females compared with males (1154 per 100,000) vs. (1033 per 100,000). There was significant regional variation in IBD prevalence (Fig. 1), with the prevalence being nearly 60% higher in the Northeast and Midwest compared to the South and West.

Prevalence of IBD also differed among racial/ethnic groups. It was highest among Non-Hispanic Whites estimated at 1099 per 100,000 (95% CI: 958 – 1261 per 100,000). The prevalence was significantly lower in Non-Hispanic Blacks (324/100,000; 95% CI: 190 – 552/100,000), Hispanics (383/100,000; 95% CI: 236 – 620/100,000), and Non-Hispanic Other (314/100,000; 95% CI: 115 – 856/100,000). Fig. 2 shows the age-specific prevalence among racial/ethnic groups, and Non-Hispanic Whites consistently exhibited higher prevalence than Non-Hispanic Blacks and Hispanics in all groups. Relative to Non-Hispanic Whites, the odds ratios for having a diagnosis of IBD associated with being Non-Hispanic Black, Hispanic, and Other Non-Hispanic race after adjusting for age, sex, and geographic region were 0.33 (95% CI: 0.19 – 0.57), 0.45 (95% CI: 0.26 – 0.77), and 0.34 (95% CI: 0.12 – 0.93), respectively.

The overall incidence of IBD was 58.7 per 100,000 and was similar between males and females (63.4/100,000 vs. 54.4/100,000). Stratified by ethnicity and race, the incidence of IBD for Non-Hispanic Whites, Blacks, and Hispanics was 70.2/100,000, 24.9/100,000, and 9.9/100,000, respectively.

Table 1 shows clinical characteristics of the adult respondents who reported having a diagnosis of IBD. The mean age at IBD diagnosis was 38.7 years and the mean disease duration was 13.6 years and did not significantly vary by ethnicity and race. Hispanics with IBD were more likely to have never smoked than Non-Hispanic Whites (78% vs. 40%, P = 0.04). About half of respondents reported having active IBD symptoms and some
functional limitation in the prior 12 months, and these proportions were not significantly different amongst racial and ethnic groups.

3.2. Hospitalization and surgery rates

In 1999, the nationwide hospitalization rate for IBD was 30.5 per 100,000 with variation by race and ethnicity as shown in Fig. 3. Rates of hospitalization were higher among Non-Hispanic Whites (32.9/100,000) compared with Non-Hispanic Blacks (23.8/100,000), Hispanics (10.4/100,000) and other Non-Hispanic racial groups (18.3/100,000). Similar trends in hospitalization rates were observed when stratified by CD and UC (Fig. 3). However, the ratio of hospitalizations to prevalence was higher among non-Hispanic Blacks (7.3%) compared with Non-Hispanic Whites (3.0%) and Hispanics (2.7%).

The overall nationwide surgery rate for IBD was 5.4 per 100,000. Among Non-Hispanic Whites, the rate of surgery was 6.2/100,000 and was higher than that for Non-Hispanic Blacks (2.9/100,000), Hispanics (1.2/100,000), and Non-Hispanic Other (2.8/100,000). However, the ratio of surgery to prevalence was higher among Non-Hispanic Blacks (0.9%) compared to Non-Hispanic Whites (0.56%) and Hispanics (0.32%).

3.3. Mortality

In 1999, the mortality rate attributable to IBD in the U.S. was 0.4/100,000. The IBD-related rate of death was highest among Non-Hispanic Whites at 0.5/100,000. The IBD mortality rate was 0.2/100,000 among Non-Hispanic Blacks while it was 0.1/100,000 among Hispanics (Table 2). The ratio of IBD-related mortality to prevalence was highest among Non-Hispanic Blacks (0.061%) compared to Non-Hispanic Whites (0.036%), Hispanics (0.026%) and Non-Hispanic Other (0.032%).

4. Discussion

Our study characterizes at a national level the burden of IBD among racially and ethnic diverse populations. Our data suggest that IBD remains a condition that predominantly affects Non-Hispanic Whites with a point prevalence 3-fold higher than that of other racial and ethnic groups. However, when compared with other racial groups, Non-Hispanic
Blacks may have experienced IBD-related hospitalizations and mortality that were disproportionately high relative to their prevalence. We estimated that there were more than 150,000 Non-Hispanic Blacks and Hispanics with IBD, and this number will continue to rise as the minority populations continue to rapidly expand over the next several decades.

Interestingly, our overall estimate of IBD prevalence was higher than that reported in the literature. We report an IBD prevalence of 908 per 100,000 which is nearly 2-fold higher than the highest estimates previously reported worldwide.\(^1\) The discrepancy is partly due to the inclusion of only those 18 years and older in our study.

Table 1  Characteristics of survey respondents with inflammatory bowel disease stratified by race/ethnicity.

<table>
<thead>
<tr>
<th></th>
<th>Overall IBD population</th>
<th>Race/Ethnicity group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-Hispanic White</td>
</tr>
<tr>
<td>Nationwide estimate of number of IBD cases</td>
<td>1,810,773</td>
<td>1,635,533</td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>38.7</td>
<td>38.7</td>
</tr>
<tr>
<td>Disease duration (yr)</td>
<td>13.6</td>
<td>14.0</td>
</tr>
<tr>
<td>Body mass index</td>
<td>28.3</td>
<td>28.3</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>50%</td>
<td>49%</td>
</tr>
<tr>
<td>Former</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Current</td>
<td>20%</td>
<td>21%</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not graduate HS</td>
<td>18%</td>
<td>16%</td>
</tr>
<tr>
<td>HS graduate or GED</td>
<td>60%</td>
<td>61%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Advanced degree</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Regular health provider</td>
<td>90%</td>
<td>91%</td>
</tr>
<tr>
<td>IBD Symptoms in past 12 months</td>
<td>51%</td>
<td>50%</td>
</tr>
<tr>
<td>Functional limitation</td>
<td>53%</td>
<td>52%</td>
</tr>
</tbody>
</table>

HS = high school.  
GED = general educational development.

* \(P = 0.04\), Hispanics compared with Non-Hispanic White.

Figure 3  The rate of hospitalizations for inflammatory bowel disease (IBD) is shown for Non-Hispanic Whites, Non-Hispanic Blacks, Hispanics, and Non-Hispanic Other. The contributions of hospitalizations for Crohn’s disease and ulcerative colitis to the overall IBD hospitalization rate are indicated by the shaded and black bars, respectively.
because IBD-related questions were only administered to adults in the NHIS. Age-specific prevalence is low in those under 18 years and increases with older age groups because it increases with disease duration for chronic diseases where mortality is low. Both Kappelman et al. and Herrinton et al. have reported rising age-specific IBD prevalence with older age groups in US populations.\textsuperscript{14,15} Thus, the exclusion of children is expected to raise the overall IBD prevalence as well as the average age of diagnosis, which we also observed in our study. The overall IBD prevalence in the Kappelman study was 504/100,000, which was still lower than our estimates.\textsuperscript{14} However, this study, like two other nationwide epidemiological studies, identified prevalent IBD cases through encounters with the health system using insurance claims data that spanned only a few years.\textsuperscript{14,16} It is possible that these studies undercounted IBD prevalent cases by failing to capture individuals in long-term disease remission who did not receive regular IBD healthcare. The use of clinic-based registries to ascertain IBD prevalence may also partly explain why epidemiological studies from Olmsted County showed a contrasting decline in age-specific prevalence with older age groups. If IBD became quiescent many decades after onset, prevalence of IBD, including individuals with inactive disease, may be undercounted in older age categories. Moreover, because the study captured only individuals in Olmsted County, prevalence may be decreased with age if older individuals, especially those who are elderly or retired, emigrate out of the region. In contrast to previous published studies, prevalent IBD cases were identified by self-report in the NHIS survey, which sampled the entire US population and did not rely on regular interactions with the healthcare system—capturing both active and inactive IBD. The latter is particularly important since half of IBD respondents in the NHIS survey reported having no IBD-related symptoms in the prior 12 months. Consequently, it may be more useful to compare the figures from our study with peak age-specific prevalence data from single counties or even states and the importance of studying geographically diverse populations to estimate IBD burden. Though these geographical variations may be due to environmental influences, they may also partly reflect racial differences in prevalence of IBD. The South and the West have relatively higher concentration of Non-Hispanic Blacks, Hispanics, and other minority groups, in whom we showed IBD to be substantially less prevalent.

The lower prevalence of IBD in Non-Hispanic Blacks and Hispanics is likely multifactorial arising from both biological and socioeconomic factors. Compared with Non-Hispanic Whites, Non-Hispanic Blacks have been shown to have substantially lower allele frequency of genetic polymorphisms, such as those in the \textit{NOD2} gene that predispose to CD.\textsuperscript{19-21} However, the lower prevalence observed in minority groups may be also be due to under-diagnosis due to suboptimal access to healthcare. Having Medicaid insurance has been shown to be associated with lower prevalence of IBD compared to being privately insured and may also be an indicator of differential access to specialists and diagnostic procedures.\textsuperscript{16}

Though the prevalence of IBD among minority groups was low, there was a disproportionately higher rate of IBD-associated hospitalization and mortality among Non-Hispanic Blacks compared to Non-Hispanic Whites that was not observed in other minority ethnic and racial groups. These racial variations in clinical outcomes may also reflect both biological and socioeconomic mechanisms. We have previously shown that there may be differences in disease phenotype between Non-Hispanic Whites and Blacks with the latter more likely to experience upper GI and perianal Crohn’s disease.\textsuperscript{22} Non-Hispanic Blacks also had lower utilization of gastroenterology care and immunomodulators and biologics even in the presence of chronic steroid use.\textsuperscript{23} Moreover, even with access to specialist care, Non-Hispanic Blacks exhibited lower adherence to medications and trust in their physicians, which in turn may erode the patient–physician relationship.\textsuperscript{24} These above factors may contribute to suboptimal outpatient care that may result in increased hospitalizations, surgery, and even mortality.

The main limitation of the NHIS component of our analysis is the ascertainment of IBD diagnosis which was by participant self-report and did not distinguish between CD and UC. It is possible that participants mistakenly over-reported an IBD diagnosis which may have partly explained a higher IBD prevalence than previously reported. We should reiterate that the questionnaire specifically queried “Crohn’s disease” and “ulcerative colitis” and not “IBD” which could easily be

<table>
<thead>
<tr>
<th>Ethnicity and race</th>
<th>No. deaths</th>
<th>Census population</th>
<th>Death rate (95% CI) (per 100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td>23</td>
<td>22,036,194</td>
<td>0.1 (0.1 – 0.2)</td>
</tr>
<tr>
<td>Black</td>
<td>713</td>
<td>151,819,063</td>
<td>0.5 (0.4 - 0.5)</td>
</tr>
<tr>
<td>Other</td>
<td>53</td>
<td>23,590,803</td>
<td>0.2 (0.2 - 0.3)</td>
</tr>
<tr>
<td>Total</td>
<td>770</td>
<td>185,057,925</td>
<td>0.4 (0.4 - 0.4)</td>
</tr>
</tbody>
</table>
mistaken for “IBS.” Furthermore, the inability to stratify our analysis by IBD subtype may obscure potential differences in the influence of demographic characteristics on the epidemiology of CD and UC. Moreover, the lack of clinical data on disease phenotype and severity precluded us from differentiating potential mechanisms for potential racial and ethnic differences in hospitalization and surgery. These disparities may arise from racial differences in disease characteristics as well as from sociocultural factors. The lack of pediatric data in the NHIS dataset also leads to an important gap in our knowledge of racial variations in IBD disease burden particularly in an age group that is experiencing an appreciable rise in incidence globally. Lastly, the IBD sample size in the NHIS is modest and limited our ability to ascertain precise estimates of incidence and to perform extensive subgroup analyses within racial and ethnic groups.

Despite these limitations, the prevalence, hospitalization, and mortality data from our analysis provide a glimpse of the burden of IBD among different racial and ethnic groups in the U.S., which has not been previously well characterized at a national level. These estimates support previous observations that there is less overall IBD disease burden among Non-Hispanic Blacks and Hispanics. These figures have implications for healthcare planning and strategies to allocate resources to optimize IBD medical care as minority populations rapidly expand in the U.S. While we acknowledge that these data were collected nearly a decade and a half ago, the most frequently cited epidemiological data on IBD among Blacks and Hispanics are even older from the 1960s to early 1980s and derived from localized populations. Data from the NHIS survey is not only more recent but reflects the entire United States population. Further research is warranted to confirm and understand why IBD-related hospitalizations surgeries, and mortality may be disproportionately high among Non-Hispanic Blacks. Data from the NHIS also suggest that the prevalence of IBD in adults is higher than previously reported, and further epidemiological studies should be undertaken to delineate whether this discrepancy is due to overestimation by self-report or underestimation by insurance claims databases that rely on regular healthcare contact and misclassification-prone administrative definitions of IBD. The NHIS survey provides the ideal infrastructure for the aforementioned endeavor. Additional clinical and medication-related questions may further support the definition of IBD and an introduction of a mechanism to confirm IBD diagnosis with medical records would augment the validity of IBD diagnosis. Moreover, analysis of IBD data over multiple years would enable a larger sample size and consequently more extensive subgroup and time trend analyses. The NHIS survey study is due for a decadal revamp in its study design in the next several years. Involvement of IBD epidemiologists would provide an invaluable opportunity to characterize IBD disease burden in the U.S. and mechanisms of potential racial disparities in outcomes.

**Funding**

G.C.N. is a recipient of New Investigator Awards from the Canadian Institutes of Health Research (CIHR), the Canadian Association of Gastroenterology, and the Crohn’s and Colitis Foundation of Canada.

**Conflicts of interest**

The authors (G.C.N., R.Y.C., and C.A.C.) report no conflicts of interest.

**Author contributions**

G.C.N., R.Y.C., and C.A.C. conceptualized and designed the study. G.C.N. performed all analyses with assistance from R.Y.C. and drafted the manuscript. All authors contributed to the critical review of the manuscript.

**References**


