

Incidence of inflammatory bowel disease by race and ethnicity in a population-based inception cohort from 1970 through 2010

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Abstract

Background: Although inflammatory bowel disease (IBD) has been more predominant in white populations, an increasing incidence of IBD in nonwhites has been reported. We sought to evaluate the incidence rates and temporal trends of IBD by race and ethnicity.

Methods: The resources of the Rochester Epidemiologic Project were used to identify 814 county residents newly diagnosed with IBD from 1970 through 2010. Race was categorized into whites and nonwhites. Ethnicity was categorized into Hispanic and non-Hispanic. Incidence rates were estimated and adjusted for age and sex to the 2010 United States (US) population. Trends in incidence rates were evaluated by Poisson regression.

Results: The adjusted annual incidence rate of IBD for whites was 21.6 cases per 100,000 person-years [95% confidence interval (CI), 20.0–23.1] and for nonwhites it was 13 per 100,000 (95% CI, 8.3–17.5). The incidence rates for whites and nonwhites increased by 39% and 134%, respectively, from 1970 through 2010. The adjusted annual incidence rate of IBD for Hispanics was 15 cases per 100,000 person-years (95% CI, 6.3–23.6) and for non-Hispanics was 20 per 100,000 (95% CI, 18.5–21.6). The incidence rate for Hispanics decreased by 56%, while the rate for non-Hispanics increased by 33%, from 1985 through 2010. In a Poisson regression, white race ($p < 0.0001$), a later year of diagnosis ($p < 0.001$), male sex ($p < 0.001$) and younger age ($p = 0.009$) were significantly associated with a higher incidence rate of IBD.

Conclusions: There were significant racial and ethnic differences in the incidence and temporal trends of IBD over the last four decades in this US population-based cohort.

Keywords: epidemiology, ethnicity, inflammatory bowel disease, race

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Introduction

The inflammatory bowel diseases (IBD), consisting of Crohn's disease (CD) and ulcerative colitis (UC), are chronic inflammatory diseases and are commonly diagnosed at younger ages with relatively low mortality.¹ The incidence of IBD continues to increase steadily in western countries, and the incidence of IBD in other continents has been rapidly increasing.² Consequently, the global prevalence of IBD appears to be climbing and this will result in an increasing burden of IBD throughout the world in the future.³

Historically, IBD has been more predominant in white populations. Recently, the descriptive

epidemiology of IBD in Olmsted County, MN, USA was updated through 2010. The incidence of CD increased from 6.9 cases per 100,000 person-years between 1970 and 1979 to 10.7 per 100,000 between 2000 and 2010, and the incidence of UC increased from 9.2 per 100,000 between 1970 and 1979 to 12.2 per 100,000 between 2000 and 2010.⁴ The diagnosis of IBD is becoming more common in other races and ethnicities. A previous systematic review highlighted temporal trends in the incidence of IBD in Hispanics and Asians.⁵ A study from Puerto Rico reported that the crude incidence of IBD in Hispanics increased from 2.6 cases per 100,000 person-years in 1996 to 7.5 per 100,000 in 2000.⁶

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A study from South Korea⁷ showed the crude incidence of CD increased from 0.05 cases per 100,000 person-years between 1986 and 1990 to 1.34 per 100,000 person-years between 2001 and 2005, while the incidence of UC increased from 0.34 per 100,000 between 1986 and 1990 to 3.08 per 100,000 between 2001 and 2005.⁷ Between 2011 and 2013, an epidemiological study across eight Asian countries illustrated the pooled incidence of IBD was 1.4 cases per 100,000 person-years.⁸ India had the highest incidence of IBD at 9.3 cases per 100,000 person-years.⁸

According to the US Census Bureau in 2015, by 2051, the US population is projected to reach 400 million and to be more racially and ethnically diverse.⁹ By 2044, more than 50% of the total population is projected to belong to a 'minority group' (defined as any racial and ethnic groups other than non-Hispanic white alone).⁹ It is therefore important to understand the burden of IBD among racial and ethnic groups in this country. Although the variation in the epidemiology of IBD among different races and ethnicities has been studied between geographic regions, population-based epidemiological data on the incidence of IBD by race and ethnicity in the US are lacking. We sought to evaluate the incidence of IBD and temporal trends from 1970 through 2010 in different racial and ethnic groups in a population-based cohort in a well-defined geographic region from Olmsted County, MN, USA.

Methods

Study setting

Olmsted County, situated in southeastern Minnesota, USA, had approximately 144,000 inhabitants at the 2010 US Census. The age, sex and ethnicity of county residents were similar to those of the state of Minnesota and the Upper Midwest. Olmsted County had less ethnic diversity than the US population (90% versus 75% white) between 1970 and 2000.¹⁰ However, by 2010, the racial diversity of county residents had changed to 85.7% whites, 5.4% Asians and 4.8% African Americans. There were 95.8% non-Hispanic and 4.2% Hispanic ethnicities.¹¹

Rochester Epidemiology Project

The resources of Rochester Epidemiology Project (REP) were used to identify permanent residents

of Olmsted County, MN, who were diagnosed with IBD between 1970 and 2010.⁴ The REP is a unique medical records linkage system that covers the entire population of Olmsted County. It has maintained a comprehensive medical records linkage system for half a century and has been continuously funded by the National Institutes of Health.¹² All of the health care for the residents of Olmsted County is provided by two organizations: Mayo Medical Center and Olmsted Medical Center. In any 4-year period, over 95% of county residents are examined at either one of the two health care systems.¹³ Approximately 98% of patients provided research authorization to REP health care providers.¹³ Demographic data, diagnosis, surgical procedure, laboratory data and drug prescriptions are electronically recorded in indexes that can be searched by computer. Thus, this population-based data resource ensures virtually complete case ascertainment and follow up in a well-defined geographic region.

Case ascertainment

The institutional review boards of both Mayo Clinic and Olmsted Medical Center approved the study. We identified all Olmsted County residents who were first diagnosed with IBD between 1 January 1970 and 31 December 2010 according to well-defined (either CD or UC) criteria as previously described.^{4,14-16} Diagnosis of CD was defined as meeting at least two of the following criteria, on two occasions, separated by ≥ 2 months: (1) clinical history of abdominal pain, diarrhea, weight loss, malaise, or rectal bleeding; (2) endoscopic findings of linear ulceration, mucosal cobblestoning, skip areas, or perianal disease; (3) radiologic findings of fistula, stricture, mucosal cobblestoning, or ulceration; (4) laparotomy appearance of 'creeping fat', bowel wall induration, and mesenteric lymphadenopathy; or (5) histologic findings of transmural inflammation or epithelioid granulomas. Diagnosis of UC was defined as meeting the following criteria, on two occasions, separated by ≥ 6 months: diffusely granular or friable colonic mucosa; and continuous mucosal involvement based on endoscopy or barium study.^{4,14-16}

The medical records of only patients who did not withdraw research authorization were reviewed. Demographic data including date of birth, date of IBD diagnosis, sex, race, and ethnicity were recorded. Race was categorized into white and

nonwhite (African American, Asian, American Indian, or other/mixed). Ethnicity was categorized into Hispanic and non-Hispanic. Racial data were available from 1970 through 2010 and ethnic data were available from 1985 through 2010.

Statistical analysis

Incidence rates in different race and ethnicity were estimated by dividing the number of county residents diagnosed with IBD by the total of population at risk. Rates were adjusted for age and sex to the 2010 US population. We also calculated the incidence rates in different race and ethnicity stratifying by calendar years of IBD diagnosis (1970–1984, 1985–1999, and 2000–2010). Poisson regression analysis was used to determine the association of race, ethnicity, age, sex, and calendar year of diagnosis with the incidence rates. An alpha-level of 0.05 was considered statistically significant.

Results

A total of 895 Olmsted County residents were diagnosed with IBD during the 1970–2010 period. A total of 77 patients with unknown racial and ethnic status and 4 patients who refused to provide the racial and ethnic information were excluded, leaving 814 patients in the study analysis.

Incidence by race

In the 1970–2010 period, a total of 776 whites and 38 nonwhites (13 African American, 11 Asian, 2 American Indian, 12 other/mixed) were diagnosed with IBD. The overall age- and sex-adjusted incidence rates for IBD in whites and nonwhites were 21.6 cases per 100,000 person-years [95% confidence interval (CI), 20.0–23.1] and 13 per 100,000 (95% CI, 8.3–17.5), respectively (Table 1). The adjusted incidence rates for IBD increased during the 1970–2010 period in both whites and nonwhites. For whites, the adjusted IBD incidence rate was 18 cases per 100,000 person-years between 1970 and 1984, 21 per 100,000 between 1985 and 1999 and 25 per 100,000 between 2000 and 2010. For nonwhites, the adjusted IBD incidence rate was 6.4 cases per 100,000 person-years between 1970 and 1984, 9.3 per 100,000 between 1985 and 1999, and 15 per 100,000 between 2000 and

2010 (Figure 1). The 30-to-59-year-old age group had the highest crude incidence rate of IBD in both whites (24.4 cases per 100,000 person-years) and nonwhites (19.6 per 100,000). Overall age-adjusted IBD incidence rates for males were relatively higher than those for females in both whites and nonwhites. In Poisson regression analysis, white race ($p < 0.001$), younger age ($p = 0.009$), male sex ($p < 0.001$) and a later calendar year of diagnosis ($p < 0.001$) were significantly associated with a higher incidence rate of IBD.

Incidence by ethnicity

In the 1985–2010 period, there were a total of 16 Hispanics and 623 non-Hispanics diagnosed with IBD. The overall age- and sex-adjusted incidence rates for IBD in Hispanics and non-Hispanics were 15 cases per 100,000 person-years (95% CI, 6.3–23.6) and 20 per 100,000 (95% CI, 18.5–21.6), respectively (Table 2). The adjusted incidence rate of IBD for Hispanics decreased from 25.4 per 100,000 between 1985 and 1999 to 11.1 per 100,000 between 2000 and 2010, while the rate for non-Hispanics increased from 17.4 per 100,000 between 1985 and 1999 to 23.1 per 100,000 between 2000 and 2010 (Figure 2). The age-adjusted incidence rate for females was numerically higher than males for Hispanics which was in contrast to non-Hispanics. Overall incidence rates for IBD in Hispanics were likely similar in all age groups (range, 12.3–17 cases per 100,000 person-years). For non-Hispanics, the 30-to-59-year-old age group had the highest crude incidence rate of IBD (23 cases per 100,000 person-years). In Poisson regression analysis, younger age ($p < 0.001$), male sex ($p = 0.001$) and a later calendar year of diagnosis ($p < 0.001$) were significantly associated with a higher incidence rate of IBD. Although non-Hispanics had a higher incidence rate of IBD than Hispanics, the association between ethnicity and higher incidence rate was not statistically significant ($p = 0.09$).

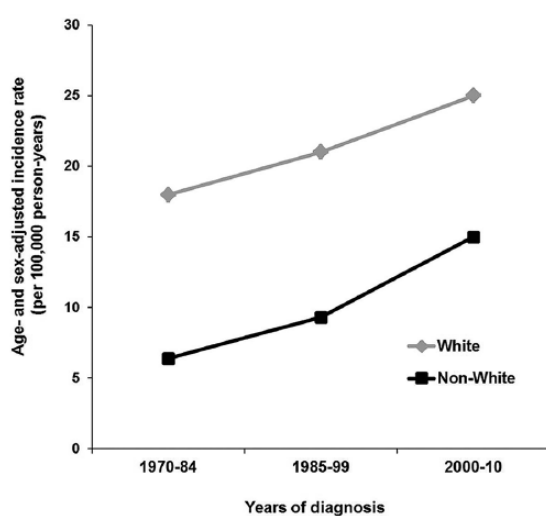
Discussion

This descriptive epidemiologic study of IBD in a population-based cohort from Olmsted County, MN, USA between 1970 and 2010 demonstrated an increase in IBD incidence by race and ethnicity. Whereas the incidence of IBD in whites was 25 cases per 100,000 person-years and that of nonwhites was 15 per 100,000 in 2000–2010, the

Table 1. Age- and sex-adjusted incidence rate for IBD by race in a population-based inception cohort from 1970 through 2010.

Race	White		Nonwhite	
	IBD, <i>n</i>	IBD incidence*	IBD, <i>n</i>	IBD incidence*
Overall	776 (424 UC/352 CD)	21.6	38 (19 UC/19 CD)	13
By year of diagnosis				
1970–1984	173	18.0	2	6.4
1985–1999	283	21.0	5	9.3
2000–2010	320	25.0	31	15.0
By sex				
Female	366	18.9	14	10.6
Male	410	24.4	24	14.8
By age, years				
0–29	318	20.3	14	7.1
30–59	355	24.4	22	19.6
60–99	103	17.5	2	11.2

*Cases per 100,000 person-years.
CD, Crohn's disease; IBD, inflammatory bowel disease; UC, ulcerative colitis.

**Figure 1.** Age- and sex-adjusted incidence rate for IBD by race in a population-based inception cohort from 1970 through 2010. IBD, inflammatory bowel disease.

rate had increased by 39% for whites and had sharply increased by 134% for nonwhites from 1970 through 2010. While the incidence of IBD

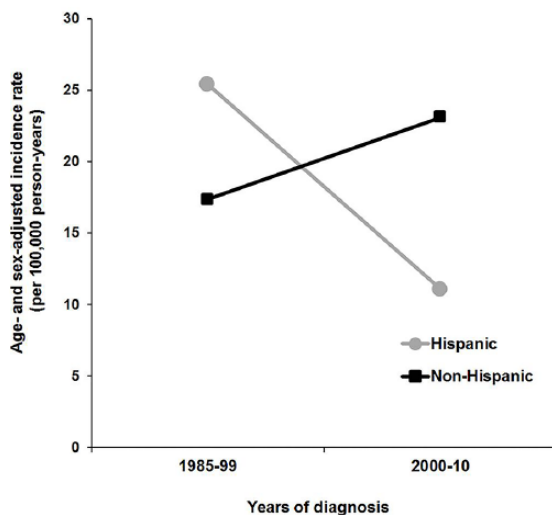
in Hispanics was 11.1 cases per 100,000 person-years between 2000 and 2010, which had decreased by 56% from 1985 through 2010, the incidence of IBD in non-Hispanics was 23.1 per 100,000 between 2000 and 2010, a 33% increase from 1985 through 2010. We found that white race, younger age, male sex and a later calendar year of diagnosis were associated with a higher incidence rate of IBD.

The racial and ethnic makeup of the USA has changed significantly in recent decades. The non-Hispanic white population has decreased from 69.1% in 2000 to 62.3% in 2015, while the Hispanic or Latino population has increased from 12.5% to 17.1% and the Asian population has increased from 3.6% to 5.1% over the same time period.¹⁷ There has been little recent research to assess the epidemiology of IBD in different racial and ethnic groups within the same geographic region. In the 1980s, a study from southern California, USA using the Kaiser Permanente Medical Care Program reported that African Americans had a CD prevalence approximately two-thirds of that of whites (29.8 cases per

Table 2. Age- and sex-adjusted incidence rate for IBD by ethnicity in a population-based inception cohort from 1985 through 2010.

Ethnicity	Hispanic		Non-Hispanic	
	IBD, <i>n</i>	IBD incidence*	IBD, <i>n</i>	IBD incidence*
Overall	16 (11 UC/5 CD)	15	623 (336 UC/287 CD)	20
By year of diagnosis				
1985–1999	6	25.4	282	17.4
2000–2010	10	11.1	341	23.1
By sex				
Female	9	19.8	286	17.4
Male	7	9.4	337	23.0
By age, years				
0–29	8	12.3	244	17.0
30–59	7	16.1	290	23.0
60–99	1	17.0	89	19.7

*Cases per 100,000 person-years.
CD, Crohn's disease; IBD, inflammatory bowel disease; UC, ulcerative colitis.

**Figure 2.** Age- and sex-adjusted incidence rate for IBD by ethnicity in a population-based inception cohort from 1985 through 2010.

IBD, inflammatory bowel disease.

100,000 person-years *versus* 43.6 per 100,000, respectively), and that Hispanics had much lower prevalence of CD (4 per 100,000).¹⁸ Nguyen and colleagues used data from the National Health Interview Study (NHIS) in 1999 to calculate the

incidence of IBD among racial and ethnic groups in the US.¹⁹ They demonstrated that the estimated incidence of IBD among non-Hispanic whites was 70.2 cases per 100,000 person-years, 24.9 per 100,000 for African Americans and 9.9 per 100,000 for Hispanics.¹⁹ In contrast to our study, although the NHIS study utilized a large database, the case ascertainment of IBD was by self-report. IBD diagnosis was not verified, and it is possible that participants may have mistakenly over-reported. For example, IBD could easily be mistaken for irritable bowel syndrome. This may explain the much higher incidence of IBD relative to other reports.¹⁴

Wang and colleagues used another survey of US households (Medical Expenditure Panel Survey, 1996–2007) to estimate the prevalence of IBD by different races and ethnicities.²⁰ Similarly, the authors showed that whites had the highest prevalence of IBD (243 cases per 100,000 person-years). The prevalence of IBD among minority groups was approximately 20–40% of that of whites. The prevalence of IBD was 96 cases per 100,000 person-years in African Americans, 85 per 100,000 in Asians, and 50 per 100,000 in Hispanics.²⁰ A US study of the military health care

population showed that the prevalence of IBD in whites was 324 cases per 100,000 person-years. The prevalence of IBD among minorities was almost 50–75% of that of whites: 239 per 100,000 in African Americans, 162 per 100,000 in Asians, and 147 per 100,000 in Hispanics.²¹ When the Medical Expenditure Panel Survey study and US military population-based study were taken into account, a trend in the increased prevalence of IBD among minorities and that of whites was observed. In our study, we found rising incidence rates of IBD in both whites (increased by 39%) and nonwhites (increased by 134%). The incidence rate of IBD in nonwhites between 1970 and 1984 was 35% of the rates of whites, and this percentage increased to 44% of the white incidence rate between 1985 and 1999 and to 60% between 2000 and 2010, accordingly.

It is important to understand the trend of disease subtype and characteristics among different races and ethnicities because this information may help inform the prognosis and management of IBD. Although several studies have assessed the differences in incidence of IBD subtype and disease phenotype among different racial/ethnic migrants worldwide, the findings should be interpreted with caution. A meta-analysis of CD incidence in South Asian (South East Asia and China) immigrants to the United Kingdom and Canada showed there was a trend towards lower incidence of CD [rate ratio (RR), 0.78; 95% CI, 0.22–2.78] but a trend towards higher incidence of UC (RR, 1.39; 0.84–2.32) among South Asians compared with whites, while data on other racial/ethnicity groups were too limited to perform analysis.²² The phenotype of colonic CD and extensive UC was more likely to be found in South Asians than in whites. The authors also noted that the significant weaknesses of most studies included their hospital-based nature and lack of standard diagnostic criteria and disease classification.²² Another systematic review of disease characteristics of IBD among racial/ethnic minorities in the US showed no differences in disease location and behavior among those groups; however, there were only a few studies that reported disease phenotype, and the results were heterogeneous.²³

Although previous studies reported the prevalence of IBD among racial and ethnic groups from the US, one must be cautious in comparing results due to different study populations and

study designs. Despite large sample sizes, some administrative studies that rely on diagnostic codes have limitations, in particular misclassification. Our study differs from previous studies in that we assembled a longitudinal population-based inception cohort within a well-defined geographic region from 1970 through 2010. All case ascertainment was based on clinical diagnostic criteria. Race and ethnic information was obtained from the electronic medical record. Each potential IBD case was manually reviewed to verify a diagnosis of IBD, race and ethnic information rather than relying on questionnaire survey or administrative data. Furthermore, our study population consisted only of permanent Olmsted County residents without influence of prevalence cases on our findings. This allowed us to determine the age- and sex-adjusted annual incidence of IBD by race and ethnicity and to also explore temporal trends. It is unclear whether differences in health-seeking behavior could change the incidence of IBD in minorities. Because of the REP, all health care in the entire Olmsted County resident population was able to be captured virtually regardless of race/ethnicity, socioeconomic status and health insurance status.¹⁰ However, there are some limitations of this study. First, the population of Olmsted County is relatively small and not as diverse racially and ethnically as that of the entire US population. Generalizability of these data to more racially and ethnically diverse populations may not be possible. Second, data for Hispanic ethnicity was only available after 1985. The prevalence of Hispanic people living in Olmsted County in 2000 was 2.4% of the total population, and the relatively rapid increase to 4.2% in 2010 may have contributed to the significant change of incidence of IBD in Hispanic people.¹¹ However, the number of Hispanic residents may be too small to draw a definitive conclusion regarding the temporal trends. Third, we initially attempted to assess the incidence of IBD subtypes (CD and UC) and disease phenotype but due to small numbers we did not perform a separate analysis by subtype. There was a relatively small number of incident CD and UC cases among different ethnic/racial groups in this study, and no conclusions could be drawn. Fourth, data on age- and sex-specificity of each race and ethnicity in the US population are not available. Therefore, we used the entire US population as a denominator for standardized calculating the age- and sex-adjusted incidence rate.

The reasons for increasing incidence rates of IBD and significant differences by race and ethnicity are relatively unknown. It has been proposed that there are genetic, host immune response, and environmental factors that contribute to the expression of IBD. To date, more than 160 IBD-susceptible genetic loci have been identified by using genome-wide association studies.²⁴ Recent studies and a meta-analysis showed that many of the IBD risk loci are shared among different racial and ethnic ancestries including whites, African Americans and Asians.^{25,26} Although there has been greatly increased understanding of the genetic risk for IBD, it remains unclear why most individuals who carry the risk loci remain healthy whereas others develop IBD. Emerging evidence suggests that environmental factors and their interaction with the host immune system in the genetically susceptible individual may be the fundamental development of IBD.²⁷ A study from Canada reported that immigrants to Ontario from all regions had a lower incidence of IBD as compared with nonimmigrants (incidence rate ratio, 0.34; 95% CI, 0.26–0.44).²⁸ However, the Ontario-born children of mothers who were immigrants from Middle East/North Africa, South Asia, Sub-Saharan Africa, western Europe and North America had similar relative incidence of IBD as children of nonimmigrants, while the incidence of IBD among the second generation of immigrants from some regions continued to be lower compared with children of nonimmigrants.²⁸ Although our study was not designed to answer this question, our findings partially provide clues for further investigations regarding the relationship between the genetic susceptibility and environmental determinants of IBD development.

In summary, there were significant differences in the incidence rate and temporal trends of IBD among racial and ethnic groups over the last four decades in this population-based cohort. An increase in the incidence of IBD for whites and nonwhites leads to an increased health economic burden in the future. Extrapolating the adjusted annual incidence to the 2010 US census, there are approximately 55,000 white and 11,000 non-white US residents newly diagnosed with IBD annually, for a total of about 66,000 US residents with a new IBD diagnosis each year. However, these estimated numbers should be considered a rough approximation of the true incident IBD cases in the US, our population are fairly

heterogenous in race and ethnicity as compared with the entire US population. To prepare for the changing landscape of the burden of IBD over the next decade with more racial and ethnic diversity, further research is warranted to understand the etiology of these differences.

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Conflict of interest statement

The authors declare that there is no conflict of interest.

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