

Analysis and Prediction Study on the Disease Burden of Inflammatory Bowel Disease Among Chinese Women of the Reproductive Age

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Purpose: To analyze the disease burden of inflammatory bowel disease (IBD) among Chinese women of reproductive age (WRA) from 1990 to 2021, as well as the projected trends through 2035.

Patients and Methods: A segmented regression analysis was carried out to assess the temporal trend of the disease burden. Additionally, the age period cohort (APC) model was applied to explore the impact of each factor on IBD. Based on the APC model, a Bayesian approach was used to predict the disease burden during the period from 2022 to 2035.

Results: In 2021, the number of Chinese WRA with IBD was approximately 38,701, with a standardized prevalence rate of 9.47 per 100,000, both of which were lower than the global averages. From 1990 to 2021, the standardized prevalence rate of IBD among Chinese WRA showed an upward trend with an average annual percentage change (AAPC) of 1.53%, while the standardized DALY rate of IBD showed a downward trend with an AAPC of -3.36%. The APC model showed that the longitudinal age curves of IBD prevalence and DALY rate increased with age. Over time, the risk of IBD among Chinese WRA showed a trend of first increasing and then decreasing, while the risk of DALY showed an overall downward trend with the passage of time. Results regarding birth cohorts indicated that the risk of IBD among Chinese WRA gradually increased with the advancement in birth cohorts, whereas the risk of DALY gradually decreased.

Conclusion: Age, period, and birth cohort have significant impacts on the disease burden of IBD among WRA. Going forward, it remains necessary to strengthen attention to the population of WRA with IBD and formulate appropriate health measures and strategies to prevent and manage the prevalence of IBD among WRA.

Keywords: women of reproductive age, inflammatory bowel disease, burden of disease, segmented regression model, age-period-cohort model

Introduction

Inflammatory bowel disease (IBD) is a chronic, recurrent autoimmune disease of the bowel of unknown etiology, including ulcerative colitis (UC) and Crohn's disease (CD).¹ It is mainly manifested as abdominal pain, diarrhea, mucus, pus, and blood in stool, etc., with the characteristics of repeated attacks.² Not only does this disease severely impact patients' quality of life and augment the family's burden, but it also has an effect on the physical and mental well-being of patients.³⁻⁵ Over the recent years, the incidence of IBD across the world keeps increasing, and obvious differences exist among different regions; high incidence in Europe and North America, and relatively low in Asia.⁶ In the European and American continents, North America and Northern Europe are areas where the incidence rate is high.⁷ Among Asian countries, China has the highest prevalence of IBD.⁸ From the age distribution point of view, IBD prevalence presents bimodal characteristics, with the first peak occurring at the age of 15-25 years old and the second peak at the age of 50-80 years old, the data show that about 50% of the IBD patients were diagnosed at the age of 35



years old, and 25% of the patients face the problem of the first birth immediately after the diagnosis of IBD.⁹ In addition, according to the 2019 Global Burden of Disease (GBD) data, most female IBD patients in China develop the disease during young and middle age, with a prevalence rate of 44.28 per 100,000, which is increasing year by year, and fertility has become one of their major concerns.¹⁰ It is evident that the first peak of prevalence is directly associated with the reproductive age group, and early-onset disease may have profound impacts on their fertility and long-term health; meanwhile, the existence of the second peak further underscores the importance of early prevention and control during the reproductive years. Therefore, it is crucial to pay attention to the prevalence of IBD among women of reproductive age.

Given China's large population base, the number of IBD patients is likely to increase over time, potentially imposing a substantial burden on the economy and healthcare system. However, studies investigating long-term trends in IBD among Chinese women of reproductive age (WRA), particularly concerning the influences of age, period, and birth cohort on disease burden, remain limited. Thus, in this research, we analyzed data from GBD 2021 database. By employing a segmented regression model, we analyzed the prevalence of IBD among Chinese WRA from 1990 to 2021, trends of DALYs, and the effects of age, time period, and cohort. Furthermore, we predicted the disease burden of IBD in this population from 2022 to 2035, to provide a theoretical reference for the subsequent formulation of IBD prevention and control policies targeting Chinese WRA.

Materials and Methods

Data Sources

The data used in this research were obtained from the 2021 Global Burden of Disease (GBD) database (<https://vizhub.healthdata.org/gbd-results/>). This database utilizes various health information indicators, such as disease statistics indicators and disease burden indicators, to assess the disease burden caused. This study utilized data for both China and the global aggregate from the GBD database spanning 1990 to 2021 to analyze the disease burden of IBD among Chinese WRA and predict future prevalence and DALY trends.

Parameters were configured within the free data download interface of GBD 2021 according to the study objectives as follows: Under “GBD Estimate”, “cause of death or injury” was selected. Under “Measure”, both “prevalence” and “DALYs” were selected. In the “Metric” column, both “number” and “rate” were selected. In the “Age” column, the following groups were selected: “15–19”, “20–24”, “25–29”, “30–34”, “35–39”, “40–44”, “45–49”, and “15–49”. In the “Sex” column, “Female” was selected. The retrieved data were saved in CSV format. For details on the GBD data extraction and analytical methods, please refer to references.^{11–13}

Case Definition

The diagnosis of IBD is determined according to the International Classification of Diseases, 10th edition (ICD–10 codes: K50–K52, K52.8–K52.9; ICD–9 codes: 555–556.9, 558–558.9, 569.5).¹⁴ Prevalence refers to the proportion of a population with a specific disease at a given time, typically expressed as a rate per 1,000 or 100,000 individuals. DALY measures the number of healthy life years lost due to disease or disability, serving as a metric to evaluate the overall burden of diseases or injuries and reflect the extent of health impairment. In this study, prevalence and DALY data were downloaded from the GBD database and presented with uncertainty intervals (UI), while metrics such as net drift, derived from APC model calculations, were reported with confidence intervals (CI). This was done to convey the uncertainty and precision associated with these estimations, thereby enabling a more thorough comprehension of the related research outcomes.

Segmented Regression Model

The method developed by the National Cancer Institute and based on R was employed to analyze the temporal trends of various disease burden indicators for IBD among Chinese WRA from 1990 to 2021. The average annual percentage change (AAPC), annual percentage change (APC), and 95% confidence interval (CI) were computed respectively. If both the estimated value of AAPC/APC and the lower limit of its 95% CI were positive, it indicated an upward trend over

a certain period; conversely, it indicated a downward trend. Additionally, if the 95% CI did not include 0, the trend of change was statistically significant ($p < 0.05$); otherwise, it was not statistically significant.¹⁵

Age-Period-Cohort (APC) Model

This model operates on the basis of the Poisson distribution. It treats different ages, periods, and birth cohorts as independent variables and analyzes their respective impacts on the disease.¹⁶ The model segments age, period and cohort in 5-year intervals, stratifies age into seven groups (ages 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49), divides the 30-year period from 1992 to 2021 into six periods, and calculates the birth cohort through the existence of a deterministic algebraic relationship between the three: birth cohort = period-age. The birth cohort was divided into a total of twelve groups. Using this modelling tool, the prevalence of IBD and DALYs in Chinese WRA was investigated in three dimensions: age, period, and birth cohort, respectively.

Bayesian Age-Period-Cohort (BAPC) Model

The BAPC model was employed to forecast the prevalence of IBD and DALYs among WRA in China from 2022 to 2035. The BAPC model operates under the premise that the age, period, and cohort effects exhibit similarity over time. It utilizes an integrated nested Laplace approximation method to estimate the marginal posterior distributions. For its establishment, we utilized the BAPC and INLA packages in the R programming language.¹⁷

Statistical Analyses

The prevalence of IBD in the WRA and DALY data were processed using R4.4.2 software to describe the burden of disease of IBD in the WRA in China and globally. To ensure the comparability of statistical indicators, age-standardised rates (asrs) were used to reduce the effects of demographic changes and age distribution over time.¹⁸

Ethics Approval

According to Article 32, Item 1 and Item 2 of the “Ethical Review Measures for Life Sciences and Medical Research Involving Human Subjects” issued by China on February 18, 2023, the following situations can be exempted from additional ethical review: (1) Research conducted using legally obtained public data, or data obtained through observation without interfering with public behavior; (2) Research using anonymized information data. Since all the data used in this study are from the publicly available GBD 2021 database. This database contains fully de-identified data at the national level and does not contain any individual-level or personally identifiable information. Therefore, our research meets the conditions that do not require additional ethical approval.

Results

Disease Burden of IBD in the WRA in China and Globally in 2021

In 2021, the number of IBD cases and DALYs among Chinese WRA accounted for approximately 4.46% and 4.22% of the global total for WRA with IBD, respectively. The number of Chinese WRA with IBD was 38,701 (95% UI=30,920, 49,214), while the global figure stood at 866,997 (95% UI=704,036, 1,053,395). Both the standardized prevalence of IBD and DALY rate among Chinese WRA were lower than the global levels. The standardized prevalence of IBD among Chinese WRA was 9.47 per 100,000, which was lower than the global average of 45.90 per 100,000 (Table 1).

IBD Burden Trends in Chinese WRA, 1990 to 2021

Between 1990 and 2021, the number of cases and prevalence of IBD among WRA showed an upward trend (Figure 1A and B), while the number of DALYs first increased and then decreased, with the DALY rate showing an overall downward trend (Figure 1C and D).

Specifically, comparing data from 1990 and 2021, the number of IBD cases among Chinese WRA increased from 21,058 to 38,701, representing an 83.78% increase. The standardized prevalence rate rose from 5.9 per 100,000 in 1990 to 9.47 per 100,000. In contrast, the total number of DALYs among Chinese WRA with IBD decreased from 17,553 to

Table 1 Burden of IBD in the WRA in 2021: China and Global Comparison

Region	Number of Cases (95% UI)	Standardized Prevalence Rate (95% UI) (per 100,000)	DALYs (95% UI)	Standardize the DALY Rate (95% UI) (per 100,000)
Global	866997.38 (704036.10, 1053395.04)	45.90 (39.71, 53.97)	281580.36 (223989.19, 349965.81)	17.75 (15.08, 21.23)
China	38701.25 (30920.73, 49214.74)	9.47 (8.05, 11.39)	11887.66 (8341.01, 16248.24)	6.23 (4.38, 9.44)

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability Adjusted Life Year; UI, uncertainty interval.

11,887, a reduction of 32.28%, and the standardized DALY rate dropped from 19.18 per 100,000 in 1990 to 6.23 per 100,000 (Table 2).

The segmented regression model showed that from 1990 to 2021, the standardized prevalence rate of IBD among Chinese WRA exhibited a fluctuating upward trend, with an AAPC of 1.53% (95% CI=0.94, 2.11. $p < 0.001$), indicating a statistically significant difference. The increase was most rapid between 2005 and 2011, with an APC of 7.87% (95% CI=6.40, 9.36. $p < 0.05$), also showing a statistically significant difference. The standardized DALY rate for the total population showed a downward trend, with an AAPC of -3.64% (95% CI=-3.82, -3.46. $p < 0.001$), indicating a statistically significant difference (Table 3).

Age-Specific Disease Burden Status of IBD Among WRA in China, 2021

In 2021, among Chinese WRA, the number of IBD cases, prevalence rate, DALYs, and DALY rate generally increased steadily with age (Figure 2A and B). Across all age groups, the 15–19-year age group had the lowest

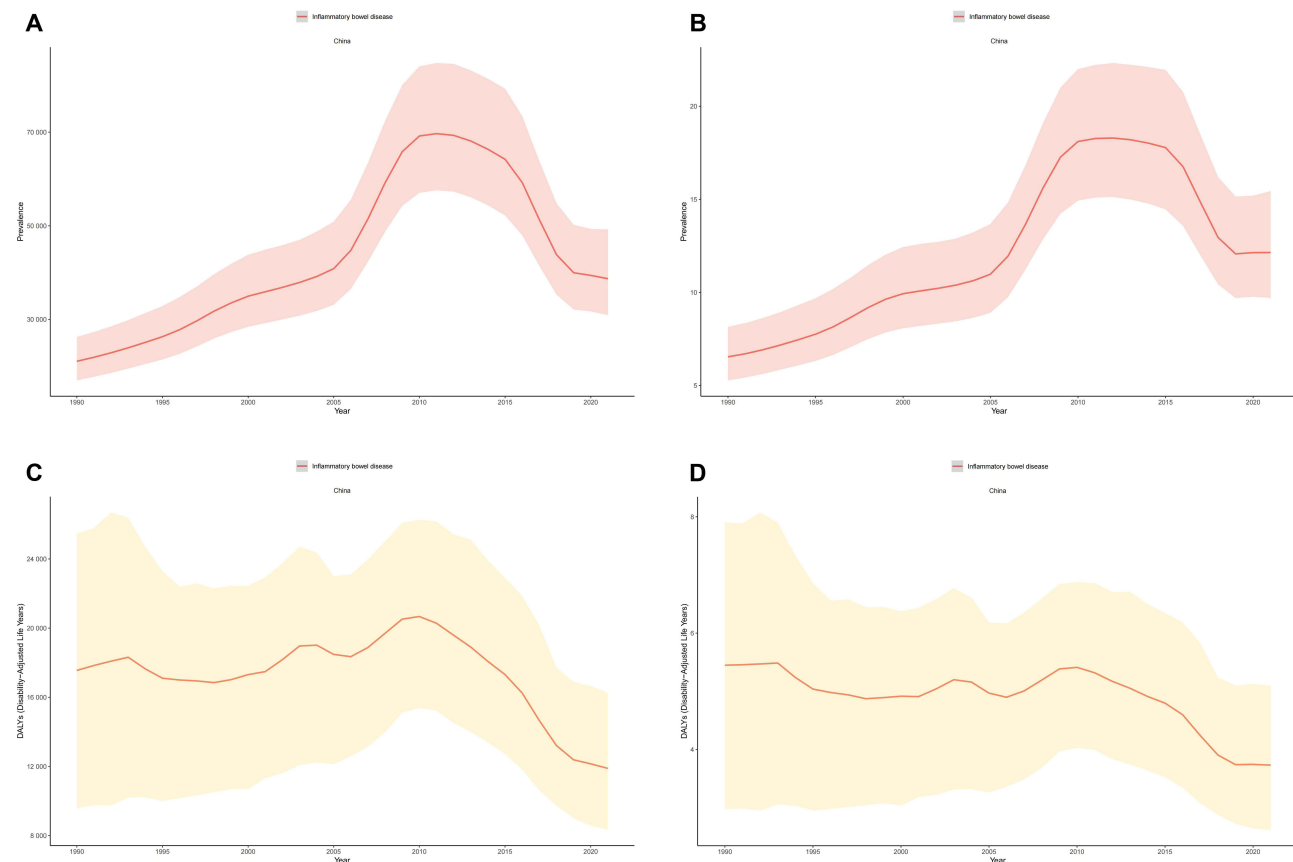


Figure 1 Trends of IBD burden among Chinese WRA, 1990–2021. **(A)** Number of prevalent cases. **(B)** Prevalence rate. **(C)** Number of DALYs. **(D)** DALY rate. In **(A)** and **(C)** the Y-axis represents absolute numbers; in **(B)** and **(D)** the Y-axis represents rates. Shaded areas indicate the upper and lower bounds of the 95% confidence interval. **Abbreviations:** WRA, Women of Reproductive Age; DALY, Disability-Adjusted Life Year.

Table 2 Prevalence and DALY Burden of IBD in Chinese WRA

Year	Prevalence			DALY		
	Number of Cases (95% UI)	Crude Rate (95% UI) (per 100,000)	Standardized Rate (95% UI) (per 100,000)	DALYs (95% UI)	Crude Rate (95% UI) (per 100,000)	Standardized Rate (95% UI) (per 100,000)
1990	21058.93 (16988.07, 26251.64)	6.54 (5.27, 8.15)	5.90 (4.99, 7.03)	17553.52 (9596.26, 25453.97)	5.45 (2.98, 7.90)	19.18 (9.09, 27.73)
2021	38701.25 (30920.73, 49214.74)	12.14 (9.70, 15.44)	9.47 (8.05, 11.39)	11887.66 (8341.01, 16248.24)	3.73 (2.62, 5.10)	6.23 (4.38, 9.44)
Change Rate	83.78%	85.63%	60.51%	-32.28%	-31.56%	-67.52%

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability Adjusted Life Year; UI, uncertainty interval.

Table 3 Disease Burden Trends of IBD in Chinese WRA, 1990 to 2021

Indicator	Trend Segment	Years	APC(% ,95% CI)	p
Standardized Prevalence	1	1990–1993	1.38(−1.86,4.74)	0.41
	2	1993–2005	3.32(2.60,4.04) ^a	<0.001
	3	2005–2011	7.87(6.40,9.36) ^a	<0.001
	4	2011–2021	−4.93(−5.69,−4.17) ^a	<0.001
	AAPC% (95% CI)	1990–2021	1.53(0.94,2.11) ^a	<0.001
Standardized DALY Rate	1	1990–1998	−2.54(−2.81,−2.27) ^a	<0.001
	2	1998–2004	−0.99(−1.65,−0.32) ^a	0.004
	3	2004–2014	−5.70(−5.89,−5.50) ^a	<0.001
	4	2014–2021	−4.08(−4.47,−3.70) ^a	<0.001
	AAPC% (95% CI)	1990–2021	−3.64 (−3.82, −3.46) ^a	<0.001

Note: a represents the 95% confidence interval (CI) did not include 0, indicating that the trend of change was statistically significant.

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability Adjusted Life Year; UI, uncertainty interval; CI, confidence interval; AAPC, Average Annual Percentage Change; APC, Annual Percentage Change.

values for the number of cases, prevalence rate, DALYs, and DALY rate, whereas the 45–49-year age group had the highest. Notably, in the 30–44-year age group, the number of IBD cases remained relatively stable with no significant increasing trend (Figure 2A).

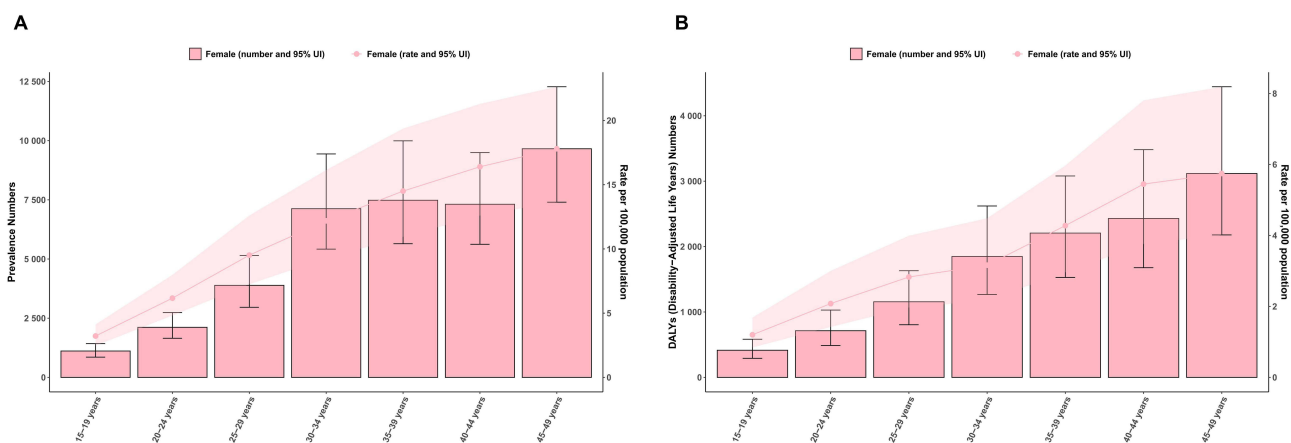


Figure 2 Age-stratified burden of IBD among Chinese women of reproductive age, 2021. **(A)** Age-related Trends of IBD Case Numbers and Prevalence in Chinese WRA, 2021. **(B)** Age-related Trends of IBD DALYs and DALY rate in Chinese WRA, 2021. Shaded areas indicate the upper and lower bounds of the 95% confidence interval.

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability-Adjusted Life Year.

APC Modelling Analysis of IBD in Chinese WRA, 1990–2021

Given that traditional trend analysis struggles to simultaneously disentangle the independent contributions of age, period, and birth cohort to disease risk, this study employed the age-period-cohort (APC) model. It used net drift to measure overall annual changes and local drift to measure annual changes within each age group, thereby identifying, respectively, the inherent risk differences across age groups reflected by age effects, the external influences at specific time points embodied by period effects, and the differences in long-term exposure represented by birth cohort effects, so as to systematically clarify the epidemiological trends of IBD among Chinese WRA from 1990 to 2021.

Net and Localized Drift Results for IBD in Chinese WRA, 1990–2021

Net drift showed that from 1990 to 2021, the prevalence of IBD among Chinese WRA exhibited a significant upward trend, with a net drift value of 2.19 (95% CI=2.0, 2.38). Conversely, the DALY rate showed a significant downward trend, with a net drift value of -1.47 (95% CI= -1.72 , -1.21).

Local drift showed that from 1990 to 2021, the IBD prevalence among Chinese WRA exhibited an upward trend across all age groups, with local drift values all > 0 (Figure 3A). In contrast, changes in the DALY rate within age groups showed a fluctuating trend of first increasing and then decreasing; yet, local drift values in all age groups were < 0 (Figure 4A), indicating that the DALY rate of IBD in all age groups of Chinese WRA still showed an overall downward trend.

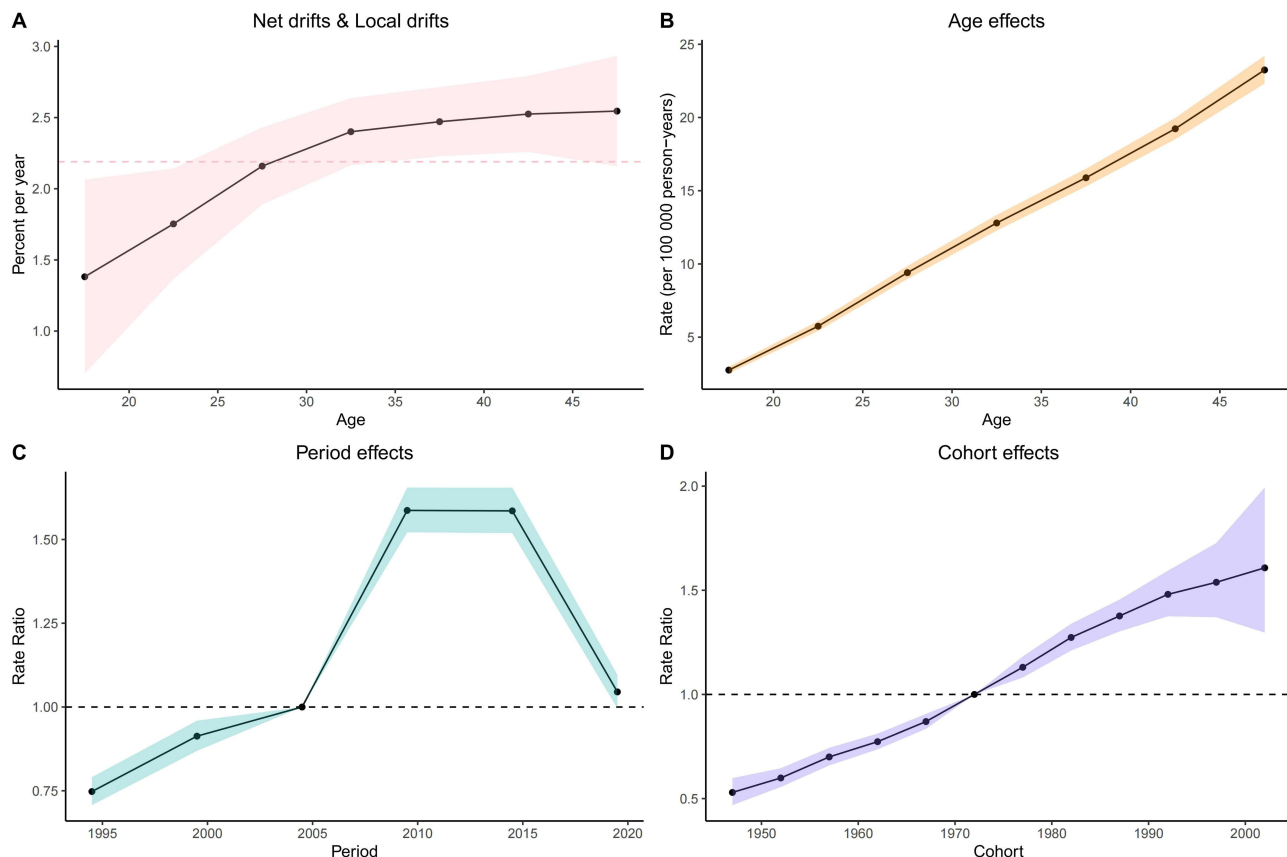


Figure 3 APC Model Analysis of IBD Prevalence in Chinese WRA, 1990 to 2021. **(A)** Net drifts and local drifts. **(B)** Age effects. **(C)** Period effects. **(D)** Cohort effects. In **(A)** the dashed red line represents the overall annual percent change of 2.19% across all ages (Net Drift), and the black line represents the local annual percent change (Local Drift). In **(C)** and **(D)** the dashed line represents the reference line (RR=1). Shaded areas indicate the upper and lower bounds of the 95% confidence interval.

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability-Adjusted Life Year; APC, Annual Percentage Change.

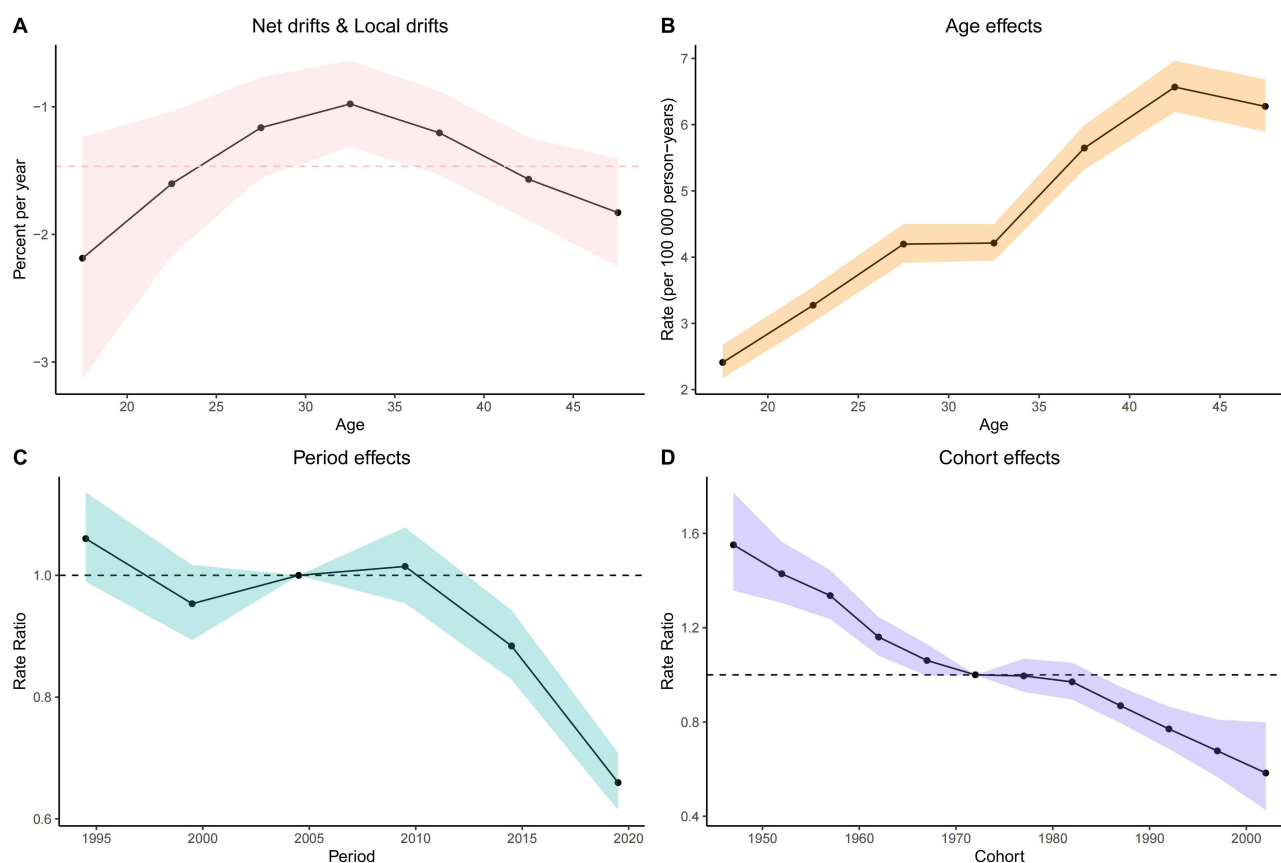


Figure 4 APC Model Analysis of IBD DALY Rates in Chinese WRA, 1990–2021. (A) Net drifts and local drifts. (B) Age effects. (C) Period effects. (D) Cohort effects. In (A) the dashed red line represents the overall annual percent change of -1.47% across all ages (Net Drift), and the black line represents the local annual percent change (Local Drift). In (C) and (D) the dashed line represents the reference line (RR=1). Shaded areas indicate the upper and lower bounds of the 95% confidence interval. **Abbreviations:** WRA, Women of Reproductive Age; DALY, Disability-Adjusted Life Year; APC, Annual Percentage Change.

Age Trends in the Prevalence of IBD and DALY Rate in Chinese WRA, 1990 to 2021

Age effect showed that both the prevalence of IBD and the DALY rate among Chinese WRA exhibited a gradual upward trend with increasing age. Specifically, the prevalence increased from 2.75 per 100,000 in the 15–19-year age group to 23.24 per 100,000 in the 45–49-year age group (Figure 3B). The DALY rate increased from 2.41 per 100,000 in the 15–19-year age group to 6.28 per 100,000 in the 45–49-year age group, suggesting that increasing age may be an important influencing factor for the prevalence and disease burden of IBD in WRA (Figure 4B).

Periodic Trends in the Prevalence of IBD and DALY Rate in Chinese WRA, 1990 to 2021

Period effect showed that the risk of IBD prevalence among Chinese WRA fluctuated with changing periods, presenting a “rise-first-then-fall” trend: With 2002–2006 as the reference period (RR=1.00), during 1992–1996, $RR < 1$, and the risk was the lowest (RR=0.75, 95% CI=0.71, 0.79), indicating a reduced relative risk. During 2007–2011 and 2012–2016, $RR > 1$, and the risk peaked (with an RR of 1.59 for both periods, 95% CI=1.52, 1.65). However, the risk decreased slightly in 2017–2021 (RR=1.05, 95% CI=1.00, 1.10) (Figure 3C), indicating an increased relative risk followed by a slight decrease.

Meanwhile, the risk of DALY rate showed an overall downward trend with changing periods: With 2002–2006 as the reference period (RR=1.00), the risk was highest in 1992–1996 (RR=1.06, 95% CI=0.99, 1.14) and dropped to the lowest in 2017–2021 (RR=0.66, 95% CI=0.61, 0.71) (Figure 4C).

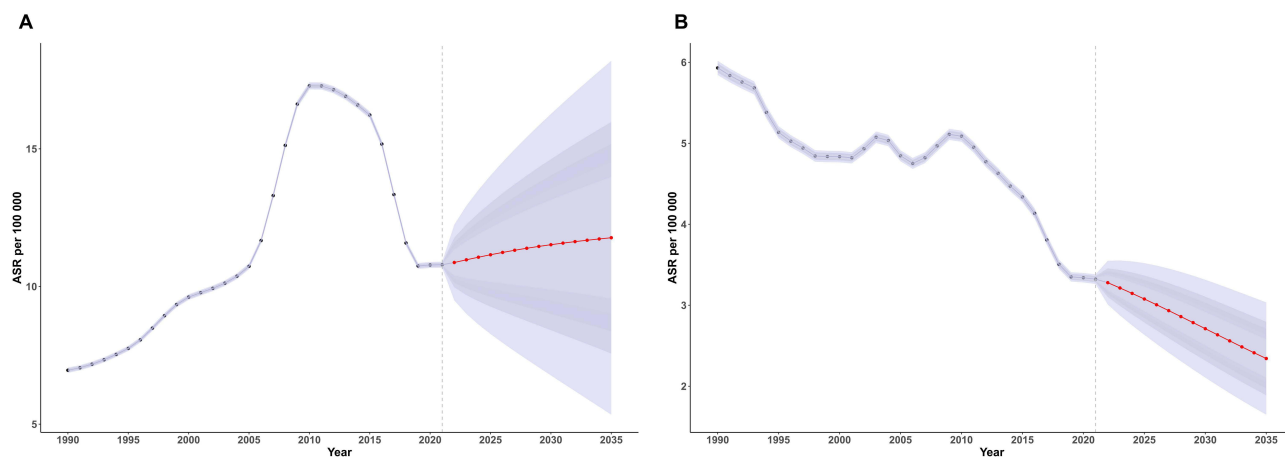


Figure 5 Prediction of standardized IBD Prevalence and DALY rate in Chinese WRA, 2022 to 2035. **(A)** Prediction of standardized IBD Prevalence. **(B)** Prediction of standardized IBD DALY rate. The red line represents the fitted projection, and the surrounding purple band represents the upper and lower bounds of the 95% confidence interval.

Abbreviations: WRA, Women of Reproductive Age; DALY, Disability-Adjusted Life Year; ASR, Age Standardized Rate; BAPC, Bayesian Age-Period-Cohort.

Birth Cohort Trends in the Prevalence of IBD and DALY Rate in Chinese WRA, 1990 to 2021

Cohort effect showed that the risk of IBD prevalence among Chinese WRA showed a gradual upward trend with the progression of birth cohorts. Using the 1972–1976 birth cohort as the reference (RR=1.00), during 1947–1951, RR < 1, with the birth cohort having the lowest risk (RR=0.53, 95% CI=0.47, 0.59), indicating a reduced relative risk of IBD prevalence among Chinese WRA; while the 2002–2006 birth cohort had the highest risk (RR=1.61, 95% CI=1.30, 1.99) (Figure 3D), indicating an increased relative risk.

Meanwhile, the risk of DALY rate showed a gradual downward trend with the progression of birth cohorts. The 1947–1951 birth cohort had the highest risk (RR=1.55, 95% CI=1.36, 1.77), and the 2002–2006 birth cohort had the lowest risk (RR=0.58, 95% CI=0.43, 0.80) (Figure 4D).

Prediction of IBD Prevalence and DALY Rate in Chinese WRA, 2022 to 2035

Based on the above data analysis, the standardized prevalence of IBD among Chinese WRA is projected to show a slow upward trend between 2022 and 2035, slightly increasing from 10.87 per 100,000 in 2022 to 11.77 per 100,000 in 2035. However, the standardized DALY rate of IBD among Chinese WRA is expected to show a downward trend over the same period, decreasing from 3.28 per 100,000 in 2022 to 2.34 per 100,000 in 2035 (Figure 5A and B).

Discussion

The standardized prevalence of IBD among Chinese WRA in 2021 was 9.47 per 100,000, significantly lower than the global average of 44.49 per 100,000. This disparity may be attributed to the traditional Chinese dietary pattern (high-fibre, low-processed foods).¹⁹ Shin Y et al demonstrated that dietary fibre has anti-inflammatory and intestinal barrier-protecting effects by regulating intestinal flora and short-chain fatty acid production.²⁰ In contrast, the high-fat diets prevalent in Western countries are associated with elevated IBD prevalence.²¹ This is because a high-fat diet disrupts the intestinal barrier, triggers inflammatory responses, breaks the balance between NK-T cells and Treg cells, and exacerbates symptoms.²² In addition, genetic factors may potentially influence differences in IBD risk. A meta-analysis found that although most IBD risk loci are shared across different ethnic groups, a few specific risk loci exhibit differences in effect sizes.²³ Global genomics research in 2023 showed that the frequency of carrying high-risk alleles for IBD in East Asian populations is significantly lower than that in European and American populations.²⁴ Therefore, it is necessary to strengthen dietary guidance and disease screening for high-risk populations to reduce the risk of the disease.

Our research findings demonstrate that the prevalence of IBD among Chinese WRA increased significantly from 1990 to 2021. The standardized prevalence rate showed a fluctuating upward trend, with the most rapid growth observed during 2005–2011, which aligns with the global trend of rising IBD prevalence.²⁵ The epidemiological evolution of IBD can be divided into four stages: emergence, accelerated incidence, composite prevalence, and prevalence equilibrium. Developing countries are in the emerging stage, while newly industrialized countries with rapid economic development are in the accelerated incidence stage.²⁶ For China, this increase may be attributed to the rapid economic development and accelerated industrialization in developing countries. As China's economic level has grown rapidly, lifestyle changes have occurred: Western-style diets high in calories, fat, and low in fiber have become increasingly common, which may have played a contributing role.²⁷ Studies have shown that such dietary patterns disrupt intestinal microbiota balance, reducing the abundance of beneficial bacteria while promoting harmful microorganism growth, thereby inducing intestinal inflammation.²⁸ At the same time, environmental factors like industrialization-induced pollution may impair gut immune and barrier functions, increasing susceptibility to IBD.²⁹

Additionally, the increased use of antibiotics and other drugs may also be one of the factors contributing to the elevated prevalence of IBD. This is because antibiotic treatment can trigger complex dynamic changes in intestinal microbiota, potentially altering the composition and physiological functions of the intestinal microbiota.³⁰ During the same period, the standardized DALY rate decreased significantly over the same period (AAPC = -0.43%). This reflects the substantial effectiveness of national advancements in medical technology and healthcare policy reforms, including the application of biologic agents and endoscopic early diagnosis in improving disease prognosis,^{31–35} as well as the New Rural Cooperative Medical Scheme in enhancing treatment accessibility.³⁶

Notably, a brief plateau in the declining trends of both prevalence and DALY rates was observed from 2019 to 2021, a period that coincided with the outbreak of the COVID-19 pandemic and the implementation of strict prevention and control measures. The potential reasons may include the redistribution of medical resources and restricted access to medical care during the pandemic, leading to delays in new diagnoses and reduced elective treatments.³⁷ Secondly, IBD patients receiving treatment with immunomodulatory biologic agents exhibit impaired humoral immunity following SARS-CoV-2 mRNA vaccination, resulting in an increased risk of breakthrough infections.³⁸ Infections themselves can induce disease recurrence, which may potentially push up both prevalence and DALY rates in the short term.

In terms of the age effect, the 2021 disease burden indicators of IBD among Chinese WRA showed a consistent upward trend with age, peaking in the 45–49-year age group. This may be attributed to age-related declines in intestinal barrier function, altered immune cell activity, and reduced pathogen resistance.³⁹ Studies by Woelfel et al found that with increasing age, *Prevotella*, *Clostridiales*, and *Bifidobacterium* gradually decrease. The loss of these microbiota impairs the production of short-chain fatty acids and antimicrobial peptides, disrupts intestinal barrier integrity, and thereby increases the risk of pathogen invasion and subsequent inflammatory responses.⁴⁰ Meanwhile, hormonal fluctuations (eg, changes in estrogen) may impair intestinal mucosal repair and immune regulation, thus increasing the risk of IBD.⁴¹

In terms of period effect, the disease risk peaks in 2007–2011 and 2012–2016 (RR = 1.59), potentially linked to economic transition-induced environmental changes and increased psychosocial stress. Studies indicate that genetic predisposition and environmental factors (such as diet and stress) disrupt immune homeostasis.^{42,43} However, the post-2017 decline in DALY risk (RR = 0.66) reflects improvements in public health awareness, healthcare access, and IBD management, which enhanced early diagnosis and treatment efficacy.

The birth cohort effect demonstrates an overall trend of fluctuating growth in disease risk, while DALY rate has gradually declined. Early birth cohorts (1992–1996), raised in relatively simple and natural environments, had more stable gut microbiota, whereas the later cohort (2002–2006) exhibited higher disease risk (RR = 1.61). This may be attributed to gut microbiota disruption from antibiotic misuse and environmental pollution, increasing IBD susceptibility.^{30,44} Meanwhile, with the continuous advancement of medical technology, the post-birth cohort is able to receive more timely and effective treatment after illness, which is an important reason for the reduced risk of DALYs.⁴⁵

This study further indicates that the standardized prevalence is projected to show a slight upward trend from 2022 to 2035, while the DALY rate will continue its downward trend, with relatively stable overall fluctuations. These findings are consistent with the research results of scholars such as Luo.⁴⁶ Potential driving factors include advancements in medical technology, which are expected to bring new therapeutic breakthroughs for IBD, including the clinical

application progress of emerging technologies such as targeted adhesion molecule therapy, cytokine inhibitors, stem cell therapy, and host-microbiome interaction-based therapies, thereby reducing disease activity and improving long-term prognosis.⁴⁷ Secondly, China's dietary prevention and control strategies may have played a positive role. Among them, the Dietary Guidelines for Chinese Residents (2022) first proposed the "Oriental Healthy Dietary Pattern" to guide residents in making scientific dietary choices, meeting the needs of normal human growth and development, immunity, and physiological functions, ensuring the supply of energy and nutrients, and reducing the risk of diet-related chronic diseases.⁴⁸ This pattern indirectly affects the risk of IBD through the dietary fiber-microbiota-immune axis mechanism.⁴⁹

However, there remains a certain degree of uncertainty in the future. New environmental risk factors may continue to emerge, such as new pollutants and unknown pathogens, which may increase the prevalence risk of IBD. Therefore, we must not relax the prevention and control of IBD due to the projected results; instead, we need to continuously monitor disease dynamics and strengthen prevention and control measures.

However, The data in the GBD 2021 disease database relies on model-derived calculations rather than direct observed data, which may introduce deviations from real-world scenarios. Future research could integrate national e-health databases with multi-centre registry studies to acquire more precise epidemiological data.

Conclusion

From 1990 to 2021, the standardized prevalence rate of IBD among Chinese WRA showed an upward trend, while the standardized DALY rate showed a downward trend. Age, period, and birth cohort had significant impacts on the disease burden. It is predicted that the prevalence rate of IBD among Chinese WRA will show a slight upward trend from 2022 to 2035, while the DALY rate will continue to show a downward trend.

Abbreviations

IBD, Inflammatory Bowel Disease; WRA, Women of Reproductive Age; DALY, disability adjusted life year; GBD, Global Burden of Disease; AAPC, Average Annual Percentage Change; APC, Annual Percentage Change.

Data Sharing Statement

The data used for these analyses are all publicly available at online GBD repository (<http://ghdx.healthdata.org/gbdresults-tool>).

Acknowledgments

We extend our gratitude to the contributors of the Global Burden of Diseases, Injuries, and Risk Factors Study 2021 for their invaluable work.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There is no funding to report.

Disclosure

The authors declare no potential conflicts of interest in this work.

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