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Global, regional, and national burden of colorectal cancer in the elderly (aged > 60 years): a comprehensive analysis across 204 countries and territories (1990–2021)

Shiyin Luo[1], Jichun Gong[1], Youwen Zhu[1], Liqun Wang[1] and Kun Zhang[1*]

Abstract

Background Colorectal Cancer (CRC) is highly prevalent among the elderly (Aged > 60 Years). Investigating the global epidemiological trends of colorectal cancer in elderly patients can aid in developing targeted prevention and control measures.

Methods The epidemiological data on CRC in the elderly were obtained from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021, encompassing annual estimates from 1990 to 2021. The acquired metrics included incidence, prevalence, deaths, disability-adjusted life years (DALYs), years lived with disability (YLDs), and years of life lost (YLLs). We analyzed temporal trends of these diverse disease burden indicators for CRC in the elderly population. Furthermore, the Bayesian age-period-cohort (BAPC) model was employed to project future the elderly CRC burden at both national and regional levels.

Results In 2021, the global elderly CRC had a total incidence of 1,617,011 (1,447,212–1,754,348), with an age-standardized incidence rate (ASIR) of 149.16 (133.11–161.91). The total prevalence was 8,079,970 (7,332,761–8,727,386), with an age-standardized prevalence rate (ASPR) of 737.47 (668.26–796.77). Total deaths numbered 827,471 (736,233–897,443), with an age-standardized death rate (ASDR) of 77.51 (68.71–84.13). Total DALYs were 15,347,705 (13,913,323– 16,592,781), with an age-standardized DALYs rate of 1407.18 (1272.56–1522.03). Total YLDs were 764,739 (562,029–991,490), with an age-standardized YLDs rate of 70.16 (51.55–90.93). Total YLLs were 14,582,966 (13,217,174– 15,764,048), with an age-standardized YLLs rate of 1337.02 (1208.87–1445.89). From 1990 to 2021, the AAPC of ASIR for global elderly CRC was 0.13 (0.12 to 0.15), the AAPC of ASPR for global elderly CRC was 0.63 (0.61 to 0.65), the AAPC of ASDR for global elderly CRC was − 0.72 (– 0.74 to– 0.69), the AAPC of Age-standardized DALYs rate for global elderly CRC was − 0.72 (– 0.73 to– 0.69), the AAPC of Age-standardized YLDs rate for global elderly CRC was 0.35 (0.33 to 0.37), the AAPC of Age-standardized YLLs rate for global elderly CRC was − 0.76 (– 0.78 to– 0.74). Projections based on the Bayesian Age-Period-Cohort model indicate that elderly CRC would continue to impose a substantial disease burden through 2025.

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Conclusion In 2021, the global burden of CRC among the elderly remained substantial. Projections to 2050 indicate that the burden of elderly CRC would continue to rise. To mitigate this burden, global efforts must prioritize early detection through expanded screening programs, improved access to treatment, and enhanced public health strategies, particularly in regions with limited healthcare infrastructure.

Keywords Colorectal cancer, Global burden, Epidemiology, Elderly

Introduction

Colorectal cancer (CRC) is a malignancy predominantly affecting older adults, posing significant threats to their health and creating formidable challenges for healthcare systems [1]. Compared to younger patients, elderly CRC often presents with atypical symptoms [2]. In some cases, the initial manifestations are not hematochezia or abdominal pain but anemia and weight loss, leading to frequent late-stage (Stage IV) diagnoses, which complicates treatment [3]. Due to advanced disease at diagnosis and weakened immune resilience, ellderly CRC patients exhibit significantly lower survival rates than their younger counterparts [4]. Postoperative complications, such as intestinal obstruction and infections, are also more prevalent in this population [5]. Moreover, elderly CRC patients require ICU admission at higher rates [6]. Additionally, some elderly CRC patients may need permanent stomas or experience cognitive decline, resulting in loss of independence and necessitating long-term care, thereby imposing substantial economic and caregiving burdens on families and society [7].

Early detection of CRC is critical for improving patient survival rates and quality of life [8]. Prevention of CRC risk factors also helps reduce the disease burden caused by CRC [9]. The development of CRC in older adults is associated with multiple risk factors, such as genetic susceptibility, lifestyle choices (including high-fat, low-fiber diets and sedentary lifestyles), chronic inflammatory bowel disease, and environmental influences [10]. Understanding the epidemiological characteristics of CRC in older adults is essential for developing targeted prevention and intervention strategies [11]. The Global Burden of Disease (GBD) database provides extensive epidemiological data on various diseases worldwide, detailing the disease burden of CRC in the general population from 1990 to 2021 [12].

Previous studies have utilized the GBD 2019 database to report the global disease burden of CRC across all age groups from 1990 to 2019 [13]. However, no research has specifically focused on the disease burden of CRC in the elderly population using the GBD database. To further provide evidence for the prevention and treatment of CRC in the elderly, we employed the GBD 2021 database to analyze the epidemiological characteristics and trends of CRC in this population and made predictions about future incidence trends.

Methods

Data sources

The GBD 2021 hosted on VizHub represents a comprehensive epidemiological assessment that integrates multidimensional data streams from national health surveys, censuses, vital registration systems, and health information databases. This methodology employs standardized protocols to ensure cross-national comparability of health metrics [14]. These data are used to evaluate various health indicators such as incidence rates. The GBD initiative adopts the International Classification of Diseases (ICD) framework for systematic disease coding and classification, enabling standardized cross-country analysis of population health trends [15]. This study extracted comprehensive elderly CRC-related incidence data from GBD 2021. The analyzed metrics included: Incidence, prevalence, deaths, Disability-Adjusted Life Years (DALYs), Years Lived with Disability (YLDs), and Years of Life Lost (YLLs) [16].

We obtained CRC case data for 8 age groups ("60–64", "65–69", "70–74", "75–79", "80–84", "85–89", "90–94", "95 plus") from the "Cause of death or injury" category in the GBD 2021 database. To evaluate the disease burden in older adults, we calculated both age-standardized rates (per 100,000 population) and absolute case numbers. The age-standardized rates facilitate comparisons across regions and time periods by adjusting for differences in population age structures, while the absolute numbers help assess real-world public health impacts and guide resource planning (including surgical resources and rehabilitation services). This dual-metric methodology follows GBD reporting conventions, where standardized rates reveal epidemiological patterns independent of demographic shifts, and absolute counts indicate actual healthcare service needs [17]. Based on the incidence rates across these age groups combined with population data from the GBD database, we calculated age-standardized disease burden metrics. Age-standardized calculations were conducted using population data from the GBD database.

Average annual percent change

We performed trend analysis of age-standardized disease burden for the elderly CRC from 1990 to 2021 using the Joinpoint Regression Program (Version 5.1.0.0). This analysis generated average annual percentage change (AAPC) values with corresponding 95% confidence

intervals (CI) [18]. Joinpoint is specialized statistical software that employs joinpoint regression modeling for trend analysis. The software processes time-series data to identify the most parsimonious joinpoint model supported by the data, while allowing users to specify the minimum and maximum number of joinpoints for evaluation [19].

Decomposition analysis

We employed decomposition analysis to investigate risk factors contributing to absolute changes in the disease burden of colorectal cancer (CRC) among older adults. Using GBD inventory data, we obtained global demographic trends (including population growth and aging patterns) from 1990 to 2021 [20]. These demographic data were then analyzed in conjunction with the previously calculated absolute measures of elderly CRC burden during the same period, enabling quantitative assessment of the driving factors behind observed changes in absolute disease burden metrics.

Prediction of future disease burden

The Bayesian Age-Period-Cohort (BAPC) model represents an epidemiological and biostatistical approach designed to analyze disease incidence patterns across temporal dimensions (age, period, and birth cohort) [21]. By integrating empirical observations with prior distributions, it generates robust parameter estimates to ensure reliable outcomes [22]. The prediction is based on GBD population data. Utilizing the BAPC and INLA packages in R (version 4.3.3), we projected incidence trends through 2050, providing evidence-based support for public health planning and preventive strategies targeting colorectal cancer (CRC) in older adults [23].

Results

Global burden analysis from 1990 to 2021

In 2021, the global elderly CRC had a total incidence of 1,617,011 (1,447,212–1,754,348), with an age-standardized incidence rate (ASIR) of 149.16 (133.11-161.91). The total prevalence was 8,079,970 (7,332,761–8,727,386), with an age-standardized prevalence rate (ASPR) of 737.47 (668.26-796.77). Total deaths numbered 827,471 (736,233–897,443), with an age-standardized death rate (ASDR) of 77.51 (68.71–84.13). Total DALYs were 15,347,705 (13,913,323– 16,592,781), with an age-standardized DALYs rate of 1407.18 (1272.56–1522.03). Total YLDs were 764,739 (562,029–991,490), with an age-standardized YLDs rate of 70.16 (51.55–90.93). Total YLLs were 14,582,966 (13,217,174– 15,764,048), with an age-standardized YLLs rate of 1337.02 (1208.87-1445.89). Detailed data on the disease burden of elderly CRC across countries and regions in 1990 and 2021 are presented in Appendix Table S1–S6. Figure 1 displays the global disease burden of elderly CRC in 2021 by type, region, and country. The disease burden of different types of elderly CRC across various SDI regions is shown in Figs. 2 and 3. Figure 4 presents the disease burden of elderly CRC across different age groups.

Global trends of elderly CRC from 1990 to 2021

From 1990 to 2021, the AAPC of ASIR for global elderly CRC was 0.13 (0.12 to 0.15), the AAPC of ASPR for global elderly CRC was 0.63 (0.61 to 0.65), the AAPC of ASDR for global elderly CRC was – 0.72 (– 0.74 to– 0.69), the AAPC of age-standardized DALYs rate for global elderly CRC was – 0.72 (– 0.73 to– 0.69), the AAPC of age-standardized YLDs rate for global elderly CRC was 0.35 (0.33 to 0.37), the AAPC of age-standardized YLLs

Fig. 1 The global incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) of CRC among elderly individuals across different age groups in 2021

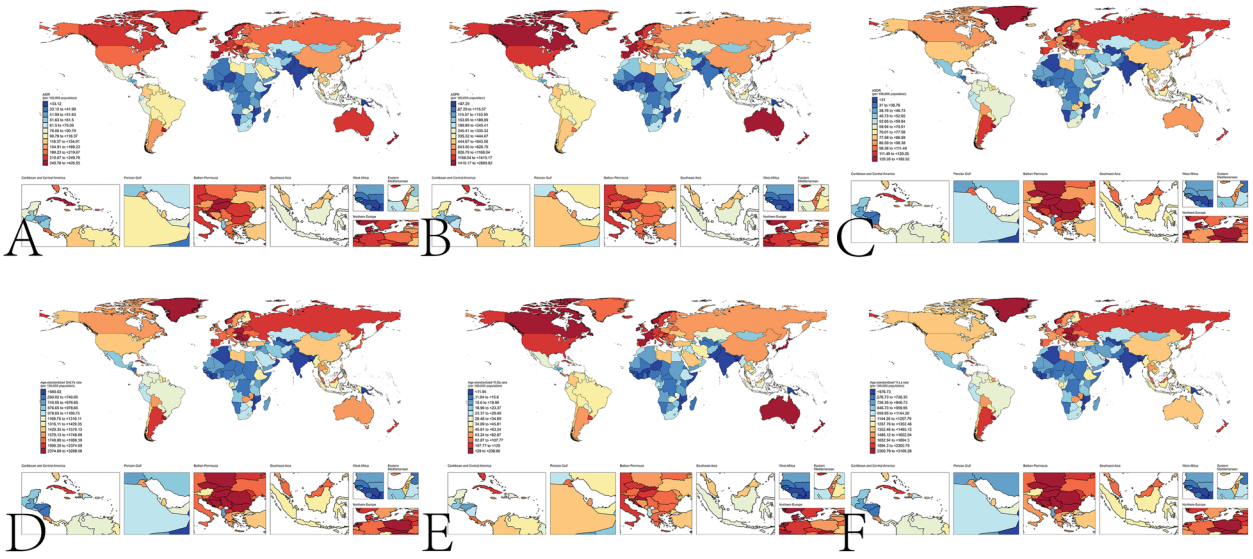

Fig. 2 The global incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) of CRC in the elderly population across various countries worldwide

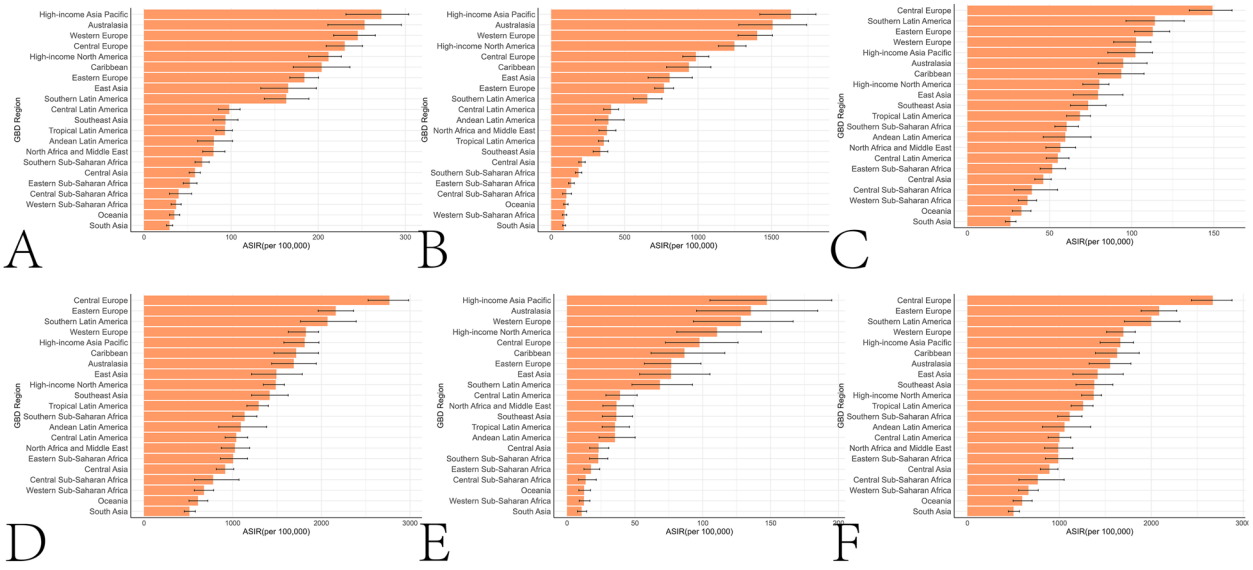

Fig. 3 The global incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) of CRC among elderly across 21 super SDI regions in 2021

rate for global elderly CRC was −0.76 (− 0.78 to− 0.74). Table S7 in Appendix and Fig. 5 present the AAPC of age-standardized rates for elderly CRC worldwide across five SDI quintiles from 1990 to 2021.

Decomposition analysis of CRC in the elderly

Based on decomposition analysis, from 1990 to 2021, the incidence case, prevalence cases, deaths cases, DALYs years, YLDs years and YLLs years of colorectal cancer (CRC) among the elderly population have increased. Population growth was identified as the most significant positive driving factor, while aging and epidemiological trends also contributed positively. The epidemic trends for deaths, DALYs, and YLLs show a declining pattern. Table S8 in Appendix and Fig. 6 present the results of the decomposition analysis.

Global projections of elderly CRC to 2050 by BAPC model

Based on the BAPC model, by 2050, the ASIR of global elderly CRC patients is projected to be 158.98 (3.25-349.64), with total incidence cases reaching 3,686,542 (89,639–7,991,353). By 2050, the ASPR of global elderly CRC patients is projected to be 815.45 (66.23–1711.40), with total prevalence cases reaching 18,229,216 (1,803,200 – 37,387,414). By 2050, the ASDR of global elderly CRC patients is projected to be

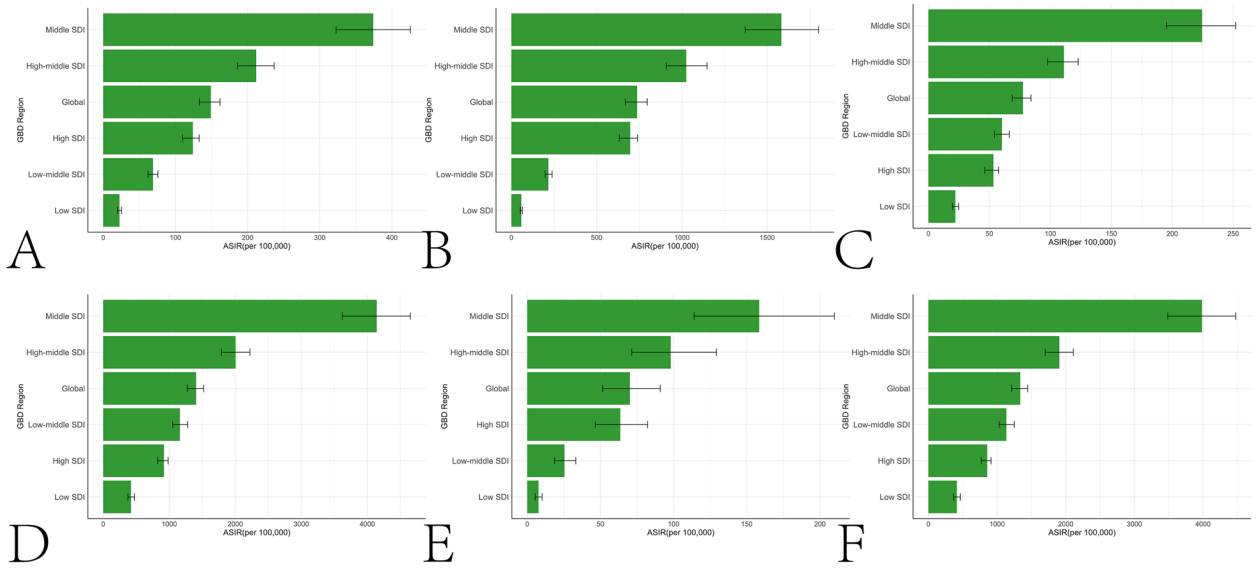

Fig. 4 The global incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) of CRC among elderly across 5 SDI regions in 2021

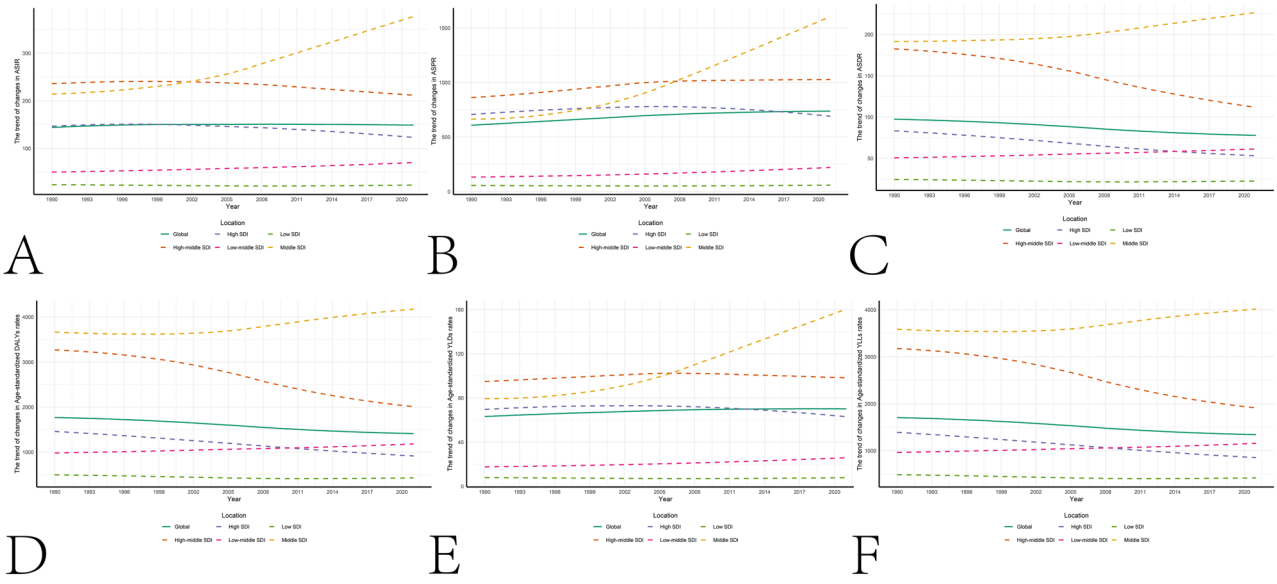

Fig. 5 Trends in Age-Standardized incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) rates for eldly CRC Globally from 1990 to 2021

70.97 (0.00–217.26), with total deaths reaching 1,729,579 (0–5,145,028). By 2050, the age-standardized DALYs rate of global elderly CRC patients is projected to be 1,303.60 (76.08–2,720.11), with total DALYs reaching 29,468,782 (2,129,527 – 60,329,926). By 2050, the age-standardized YLDs rate of global elderly CRC patients is projected to be 74.39 (0.00–207.57), with total YLDs reaching 1,693,964 (0–4,771,148). By 2050, the age-standardized YLLs rate of global elderly CRC patients is projected to be 1,234.32 (67.11–2,586.37), with total YLLs reaching 27,888,594 (1,882,963 – 57,343,866). Table S9-14 in Appendix and Fig. 7 present the results of the decomposition analysis.

Discussion

According to the GBD 2021 data, we found that in 2021, the global ASIR of CRC among the elderly reached 149.16, indicating approximately 150 new CRC cases per 100,000 elderly individuals. This result highlights that CRC remains a significant disease burden in the elderly population. This finding underscores the importance of routine CRC screening in the elderly population. Current guidelines also recommend annual guaiac-based fecal occult blood testing and colonoscopy for the elderly [24]. Furthermore, the GBD 2021 data revealed an exceptionally high ASPR of 737.47 per 100,000 elderly individuals for CRC. This elevated prevalence may be attributed to

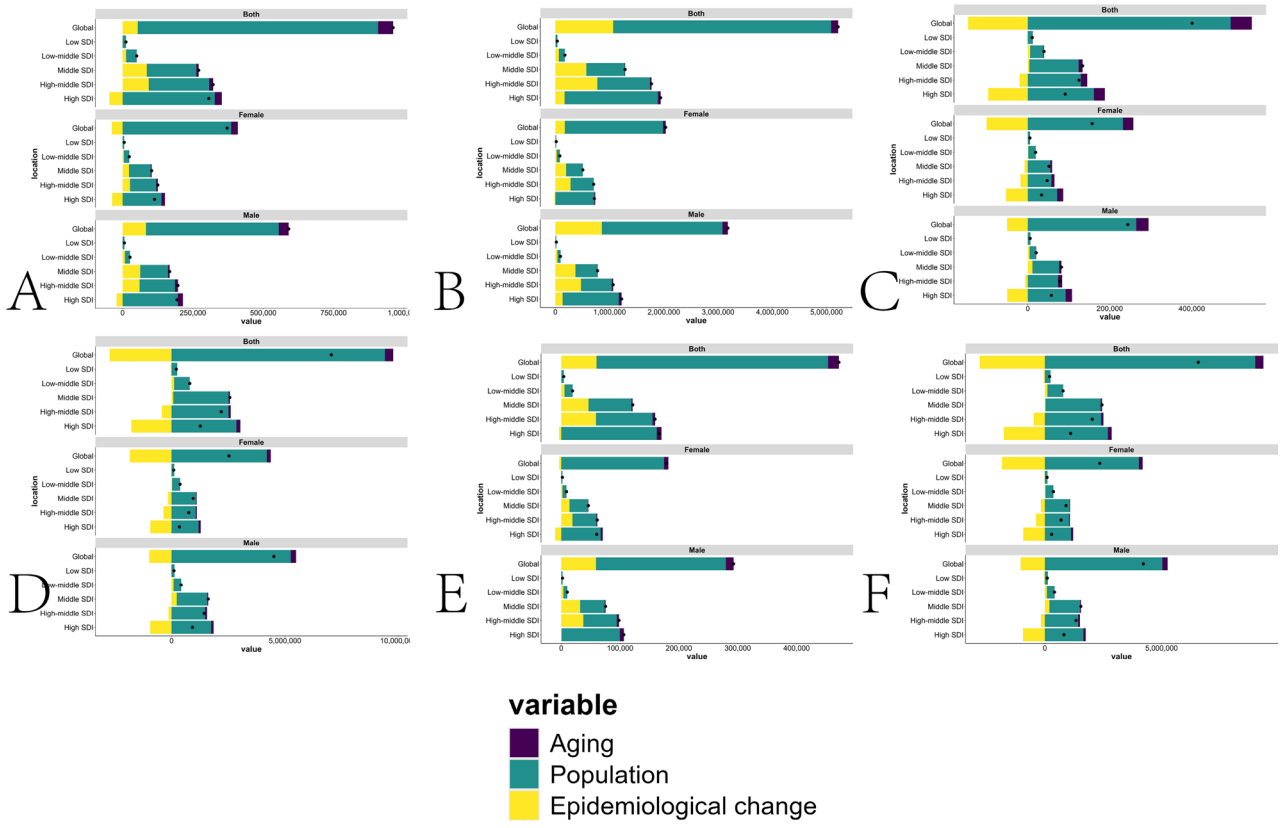

Fig. 6 The decomposition analysis results of Age-Standardized incidence (**A**), prevalence (**B**), deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**) rates of CRC in the elderly from 1990 to 2021

the relatively prolonged survival of elderly CRC patients. A proportion of these patients achieve long-term tumor-bearing survival through active treatment, with the majority being early-stage cases [25]. This finding further underscores the critical importance of early CRC diagnosis [26]. The ASDR of elderly CRC was 77.51 per 100,000, remaining at a high level yet lower than its ASIR. These findings indicate that while elderly CRC maintains considerable lethality, many patients can achieve prolonged survival through appropriate treatments [27]. Emerging technologies including minimally invasive surgeries have been shown to effectively reduce mortality rates in elderly CRC patients [28]. Elderly CRC contributes to substantial DALYs, with YLLs significantly exceeding YLDs. These findings suggest that many elderly CRC patients are diagnosed at advanced stages, precluding curative treatment and resulting in considerable YLLs. Early detection remains the critical determinant for achieving cure or clinical remission in elderly CRC [29]. This evidence further reinforces the imperative of implementing early CRC screening programs for the aging population [30].

Our study analyzed the disease burden of elderly CRC across different age groups and sexes in 2021. The population pyramid showed higher CRC incidence in elderly males than females. Among elderly males, the 85–89 age group had the highest CRC incidence, while incidence increased progressively with age in elderly females. Both elderly males and females showed peak CRC prevalence in the 85–89 age group. Males were more likely to smoke and drink alcohol than females - both established risk factors for CRC [31]. Additionally, compared to females, males tended to consume higher-fat and lower-fiber diets, a pattern strongly associated with CRC development [32]. These factors collectively explain the higher CRC incidence observed in elderly males compared to females.

To better understand the epidemiological characteristics of elderly CRC, we employed Joinpoint Regression analysis. The results revealed a slight upward trend in the ASIR of elderly CRC over the past three decades. This may be associated with increased CRC screening uptake and persistent risk factors such as obesity and low-fiber diets [33]. Notably, the ASPR of elderly CRC showed significantly faster growth compared to ASIR. This finding reflects therapeutic advances, including targeted therapies, which have prolonged survival in elderly CRC patients, leading to an accumulation of prevalent cases[34]. Consequently, both the ASDR and age-standardized YLLs rate demonstrated declining trends. The extended survival of elderly CRC patients

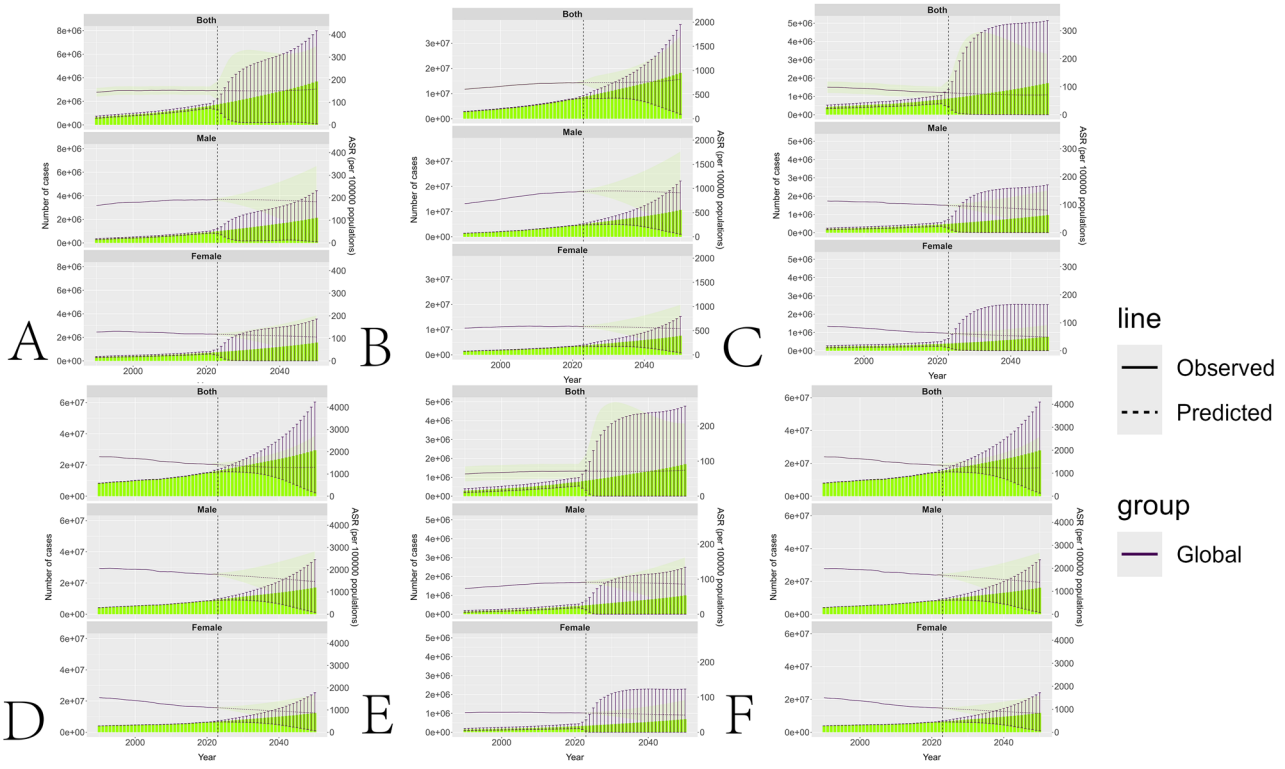

Fig. 7 The projections of elderly CRC based on the BAPC model, illustrating the predicted incidence (**A**), prevalence (**B**), and deaths (**C**), DALYs (**D**), YLDs (**E**) and YLLs (**F**)

has resulted in longer periods of tumor-bearing survival, though treatment-related side effects or complications may have contributed to increased disability burden, as evidenced by the rising trend in age-standardized YLDs rate [35]. These findings highlight, first and foremost, the importance of primary prevention [36]. Measures such as healthy dietary habits, tobacco control, and alcohol moderation should continue to be implemented to prevent elderly CRC onset [37]. Persistent CRC screening in the elderly population facilitates early detection and timely treatment, thereby improving patient prognosis [38]. The increase in YLDs indicates that CRC is gradually transitioning into a chronic disease management model alongside therapeutic progress [39]. While clinical remission can be achieved, equal attention must be paid to maintaining patients' quality of life during survivorship [40].

We employed the BAPC model to project future incidence, prevalence, and mortality rates of CRC in the elderly population. This modeling approach has been extensively utilized in predicting disease epidemiology trends [41]. The BAPC model generates projections by analyzing historical age, period, and cohort effects in elderly CRC, with its predictive capacity being iteratively reinforced through ongoing data assimilation [42]. This methodological characteristic contributes to the observed wide confidence intervals in projection outcomes [43]. Technological advancements in screening modalities (such as liquid biopsy) and the development of novel therapeutic interventions may potentially reduce the disease burden of elderly CRC beyond current estimates [44]. While acknowledging these limitations, the model's projections nevertheless provide valuable preliminary insights into future epidemiological trends of elderly CRC. The analysis indicates that CRC would continue to pose a substantial disease burden in aging populations globally. Given that early diagnosis remains the most critical determinant of patient prognosis, the implementation of comprehensive screening protocols—including colonoscopy—for elderly populations worldwide remains imperative [45]. Early detection of colorectal cancer in older adults not only holds the potential to save lives and improve quality of life for patients, but also represents a significant reduction in healthcare expenditures through avoided late-stage treatments [46].

This study has several limitations. First, GBD data relies on model-based estimates, and variations in primary data quality across different regions and countries may introduce bias into the source datasets. This could lead to inaccurate estimations of the true burden of CRC in the elderly population - for instance, potential underestimation in low-income countries due to inadequate regional infrastructure and policy frameworks, or overestimation in nations where data primarily comes from urban

settings. Second, the predictive model shows that confidence intervals widen as the projection period extends, which may reduce the reliability of predictions. Third, since the GBD database only provided data on population, aging, and epidemiological trends based on absolute disease burden changes, our decomposition analysis was consequently limited to examining these specific parameters. The analysis did not include further investigation into factors such as high BMI or red meat consumption that may contribute to changing trends in elderly CRC incidence. Furthermore, targeted interventions and prevention strategies specifically for elderly CRC could alter incidence rates, thereby affecting the predictive accuracy of the model.

Conclusion

In 2021, the global burden of CRC among the elderly remained substantial. Projections to 2050 indicate that the burden of elderly CRC would continue to rise. To mitigate this burden, global efforts must prioritize early detection through expanded screening programs, improved access to treatment, and enhanced public health strategies, particularly in regions with limited healthcare infrastructure.

Abbreviations

ASIR	Age-standardized incidence rate
ASPR	Age-standardized prevalence rate
ASDR	Age-standardized deaths rate
CI	Confidence interval
GBD	Global burden of disease
SDI	Socio-demographic index
AAPC	Annual percentage change
YLDs	Years lived with disability
YLLs	Years of life lost
DALYs	Disability-adjusted life years

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12876-025-04184-4.

Supplementary Material 1

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Author contributions

Study concept and design: Shiyin Luo. Acquisition of data: Jichun Gong. Data analysis and interpretation: Youwen Zhu. Drafting the manuscript: Liqun Wang. Critical revision of manuscript: Kun Zhang. All authors had full access to all the data in the study and had final responsibility for the decisions to submit for publication. Shiyin Luo and Jichun Gong contributed equally to this work. Liqun Wang and Kun Zhang contributed equally to this work.

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Data availability

Data at national level can be found at: http://ghdx.healthdata.org/gbd-results-tool. All subnational level data used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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