The burden of colorectal cancer in Iran during 1995-2019: Findings from the Global Burden of Disease study

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Abstract

Colorectal cancer (CRC) is the third most commonly diagnosed malignancy and the second leading cause of cancer-related mortality worldwide. According to GLOBOCAN projections, the global burden of CRC is expected to affect approximately 3.2 million individuals by 2040. This study aims to evaluate the temporal trends in the burden of CRC in Iran by analyzing disability-adjusted life years (DALYs) from 1995 to 2019. Data were retrospectively obtained from the Global Burden of Disease (GBD) reports, published by the Institute for Health Metrics and Evaluation (IHME). The burden of CRC was assessed using DALYs, incidence, and prevalence rates, stratified by sex and age group over the study period. Statistical significance was determined using the Jonckheere-Terpstra test and t-tests at a 5% significance level. Between 1995 and 2019, CRC accounted for approximately 2.4 million DALYs in Iran, with males contributing 1,330,961 DALYs and females 1,095,938 DALYs. The incidence rate increased from 4.63 per 100,000 population during 1995–1999 to 10.85 per 100,000 during 2015–2019, while the prevalence rate rose from 19.32 to 49.45 per 100,000 population. Over the same period, a total of 94,188 CRC-related deaths were recorded, with a higher mortality rate observed among males compared to females. The findings demonstrate significant variations in CRC burden across different age and sex groups. CRC remains a major public health concern, with increasing incidence and prevalence. The majority of DALYs

were attributable to years of life lost (YLLs) due to premature mortality, highlighting the critical need for early detection and preventive strategies.

Keywords: Colorectal Neoplasms, Disability-adjusted life years (DALYs), Global Burden of Disease (GBD)

1. Introduction

Colorectal cancer (CRC), a malignancy affecting the colon and rectum, represents a significant global public health challenge. It is the third most commonly diagnosed cancer in men and the second in women, accounting for over 10% of all cancer cases worldwide (1). According to GLOBOCAN projections, the global burden of CRC is expected to reach approximately 3.2 million cases by 2040 (2). Each year, nearly one million deaths are attributed to CRC, with the highest mortality rates reported in Asia (3). In 2019, the age-standardized mortality rate per 100,000 population was 17.41 in the Americas, 3.7 in Africa, 35.21 in Europe, and 12.31 in Asia (4).

In 2020, Hungary, Slovakia, Norway, the Netherlands, and Denmark reported the highest age-standardized incidence rates of CRC, with 45.3, 43.9, 41.9, 41.0, and 40.9 cases per 100,000 population, respectively. In contrast, the lowest incidence rates—fewer than 4 cases per 100,000—were observed in Guinea, Gambia, Bangladesh, Bhutan, and Burkina Faso (5). While the incidence of CRC has stabilized or declined in many high-income countries—including Australia, New Zealand, the United States, and several Western European nations—it is increasing rapidly in numerous low- and middle-income countries, including Iran (6).

In Iran, CRC has shown a notable upward trend. It rose from being the 7th and 25th leading cause of disability-adjusted life years (DALYs) in men and women, respectively, in 1990, to the fourth leading cause for both sexes by 2017. CRC is currently the third most common cancer in Iranian men and the second in women. Correspondingly, CRC-related mortality has increased from 2.87 per 100,000 in the early 1990s to 6.8 per 100,000 in 2017 (7). The estimated 5-year survival rate for CRC in Iran is 0.50 (0.56–0.44) in women and 0.44 (0.40–0.48) in men (8).

CRC imposes a considerable health and economic burden on the Iranian population. However, despite its rising impact, there remains a scarcity of comprehensive studies examining the long-term burden of CRC at the population level in Iran (9, 10). In response, this study aims to assess the burden of CRC in Iran from 1995 to 2019 using data from the Global Burden of Disease (GBD) study. Unlike previous Iranian studies that have focused primarily on incidence rates, aggregated cancer data, or regionally limited analyses, this research provides a nationwide, 25-year DALY-based evaluation of CRC. Moreover, it offers the first age- and sex-stratified national estimates of CRC burden over time.

2. Materials and Methods

2.1. Data sources

This study utilized two primary categories of data: colorectal cancer burden metrics and Iranian population statistics. Colorectal cancer burden data included Disability-Adjusted Life Years (DALYs), Years of Life Lost (YLLs), Years Lived with Disability (YLDs), number of deaths, incidence, and prevalence. These data were retrospectively extracted from the GBD reports, published by the Institute for Health Metrics and Evaluation (IHME), covering the period from 1995 to 2019 (4). Population data for Iran, stratified by sex and age group, were obtained from the World Bank Statistics and the Iranian Statistical Center.

2.2. Data analysis

This study represents a secondary analysis of GBD study results. Mortality and morbidity indicators were employed to evaluate the burden of colorectal cancer. Crude rates of mortality, incidence, and prevalence were reported, along with DALYs, YLLs, and YLDs, stratified by age group and sex for the years 1995–2019. Age groups were defined in accordance with the World Health Organization (WHO) and previous studies, including: <5 years, 5–14 years, 15–49 years, 50–69 years, and ≥70 years.

DALY, a composite measure developed by the WHO, was used to quantify and compare the burden of disease across populations and time periods. This metric is particularly useful in evaluating the impact of diseases and guiding health policy by incorporating both premature mortality (YLLs) and non-fatal health outcomes (YLDs). One DALY represents the loss of one year of healthy life due to illness, disability, or premature death (11).

Descriptive statistics included the number of cases and rates of incidence, prevalence, DALYs, YLLs, and YLDs, all stratified by age and sex. Analytical statistics were performed to assess significant differences in burden across demographic groups. Independent t-tests were used to compare means across age groups and sexes, while the Jonckheere-Terpstra test was applied to evaluate temporal trends. All statistical analyses were conducted using Stata version 14 (Stata Corp, College Station, TX, USA). A p-value < 0.05 was considered statistically significant.

3. Results

Between 1995 and 2019, a total of 94,188 colorectal cancer (CRC)-related deaths were recorded in Iran across both sexes, with a consistently higher incidence observed in males compared to females. Over this period, the incidence rate of CRC increased from 4.63 to 7.19 per 100,000 population. Similarly, the prevalence rate rose from 19.23 to 31.83 per 100,000 population for both sexes combined (Table 1).

Table 1. The number of deaths, incidence, and prevalence rate of colorectal cancer in Iran during 1995- 2019

Years	Death number				Incidence rate[a] per 100,000				Prevalence rate[a] per 100,000			
	Male	Female	Both	P-value	Male	Female	Both	P value	Male	Female	Both	P value
1995-1999	5839	4693	10533	0.075	5.36	3.87	4.63	0.002	23.51	14.98	19.32	<0.0001
2000-2004	7264	5877	13141		6.48	3.45	4.99		28.95	18.15	23.62	
2005-2009	9615	7919	17533		8.01	5.74	6.89		36.19	22.36	29.38	
2010-2014	12655	10581	23236		10.02	7.12	8.60		46.74	27.70	37.36	
2015-2019	16381	13364	29745		13.03	8.62	10.8		63.63	34.91	49.45	
All years	51754	42434	94188		8.58	5.76	7.19		39.81	23.62	31.83	

a; Incidence and prevalence rate was calculated as an average for the period.

Table 2 presents the total number of deaths and DALYs attributable to CRC in Iran, stratified by age group, for the period 1995–2019. During this time, CRC accounted for an estimated 2,426,900 DALYs across all age groups, with males contributing 1,330,961 DALYs and females 1,095,938 DALYs. The total number of CRC-related deaths over the same period was 94,189.

Table 2. Colorectal Cancer Mortality and DALYs Across Different Age Groups in Iran (1995-2019)

Age groups	DALYs number			Death number		
	Female	Male	Total	Female	Male	Total
Under 5	0	0	0	0	-	0
5-14 years	7,965	8,809	16,773	100	109	208
15-49 years	321,989	363,879	685,868	6,377	7,204	13,582
50-69 years	481,990	599,609	1,081,599	16,126	19,981	36,107
>70 years	283,995	358,665	642,660	19,832	24,460	44,292
All ages	1,095,938	1,330,961	2,426,900	42,434	51,754	94,189

Among females, total YLLs rose from 128,617 in 1995–1999 to 322,554 in 2015–2019, while males showed a rise from 156,008 to 398,242 over the same period. Similarly, YLDs increased from 2,506 to 7,525 among females and from 3,871 to 13,127 among males. Total DALYs increased markedly: in females, from 131,122 in 1995–1999 to 330,077 in 2015–2019; in males, from 159,876 to 411,369 during the same periods. Age-specific analysis showed the greatest burden among individuals aged 50 and older. The Jonckheere–Terpstra trend test confirmed a significant increasing trend in YLLs, YLDs, and DALYs across all age groups ($P < 0.001$). Additionally, The Onaway ANOVA shows a significant difference in the number of DALYs, YLLs and YLDs based on age groups (Table 3).

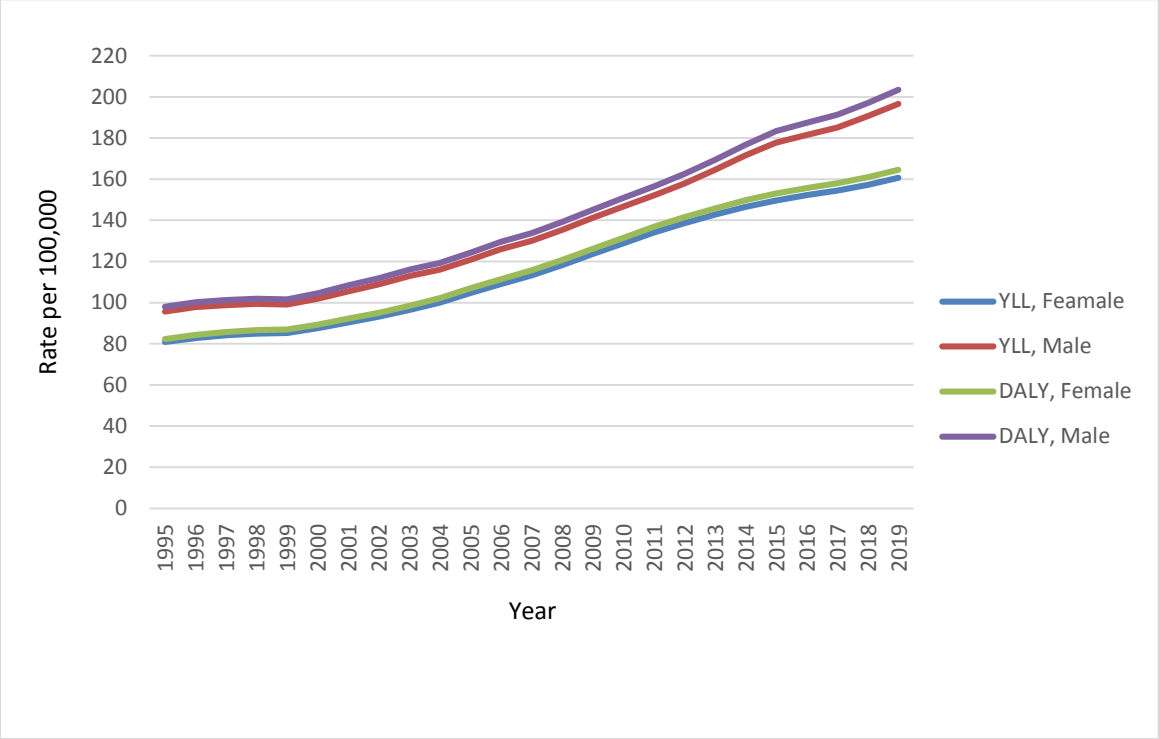
Table 3. YLLs and YLDs Due to Colorectal Cancer Across Different Age Groups in Iran (1995-2019)

Indicator	Sex	Age Group (years)	1995–1999	2000–2004	2005–2009	2010–2014	2015–2019	Jonckheere-Terpstra test[a] (P-Value)	Onaway ANOVA[b] (P-Value)
YLLs	Female	5–14	1,935	1,623	1,386	1,567	1,332	Z= -4.62 (<0.001)	F= 105 (<0.001)
YLLs	Female	15–49	42,245	50,187	61,712	75,993	86,203	Z=7 (<0.001)	
YLLs	Female	50–69	56,001	65,110	86,543	116,388	147,873	Z=7 (<0.001)	
YLLs	Female	≥70	28,436	38,413	52,907	69,816	87,146	Z= 7 (<0.001)	
YLLs	Female	All ages	128,617	155,333	202,548	263,764	322,554	Z= 7 (<0.001)	
YLLs	Male	5–14	2,149	1,795	1,551	1,738	1,375	Z= -4.71 (<0.001)	F= 100 (<0.001)
YLLs	Male	15–49	42,273	51,804	67,492	88,073	105,244	Z=7 (<0.001)	
YLLs	Male	50–69	74,611	81,870	102,557	135,790	186,117	Z= 6.86 (<0.001)	
YLLs	Male	≥70	36,975	50,748	68,697	86,675	105,506	Z= 7 (<0.001)	
YLLs	Male	All ages	156,008	186,217	240,297	312,276	398,242	Z= 7 (<0.001)	
YLDs	Female	5–14	28	25	22	23	24	Z= -2.73 (0.006)	F= 76.85 (<0.001)
YLDs	Female	15–49	691	874	1,084	1,328	1,671	Z=7 (<0.001)	
YLDs	Female	50–69	1,104	1,347	1,788	2,448	3,388	Z=7 (<0.001)	
YLDs	Female	≥70	683	979	1,354	1,818	2,442	Z= 7 (<0.001)	
YLDs	Female	All ages	2,506	3,225	4,248	5,617	7,525	Z= 7 (<0.001)	
YLDs	Male	5–14	44	40	37	40	39	Z= -2.21 (0.026)	F= 62.12 (<0.001)
YLDs	Male	15–49	890	1,209	1,643	2,220	3,033	Z=7 (<0.001)	
YLDs	Male	50–69	2,000	2,422	3,128	4,362	6,752	Z=7 (<0.001)	
YLDs	Male	≥70	937	1,384	1,928	2,513	3,303	Z= 7 (<0.001)	
YLDs	Male	All ages	3,871	5,055	6,736	9,135	13,127	Z= 7 (<0.001)	
DALYs	Female	5–14	1,963	1,648	1,408	1,591	1,355	Z= -4.67 (<0.001)	F= 99.39 (<0.001)
DALYs	Female	15–49	42,936	51,062	62,796	77,322	87,874	Z= 7 (<0.001)	
DALYs	Female	50–69	57,104	66,457	88,332	118,836	151,260	Z=7 (<0.001)	
DALYs	Female	≥70	29,119	39,392	54,261	71,634	89,588	Z= 7 (<0.001)	
DALYs	Female	All ages	131,122	158,559	206,797	269,383	330,077	Z= 7 (<0.001)	
DALYs	Male	5–14	2,193	1,835	1,588	1,778	1,414	Z= -4.71 (<0.001)	F= 105.22 (<0.001)
DALYs	Male	15–49	43,162	53,013	69,135	90,292	108,277	Z= 7 (<0.001)	
DALYs	Male	50–69	76,610	84,293	105,685	140,152	192,869	Z= 6.86 (<0.001)	
DALYs	Male	≥70	37,911	52,133	70,625	89,188	108,809	Z= 7 (<0.001)	
DALYs	Male	All ages	159,876	191,274	247,033	321,410	411,369	Z= 7 (<0.001)	

a; The Jonckheere-Terpstra test indicates that the DALYs, YLLs and YLDs number of colorectal l cancer has a significant trend from 1995 to 2019. b; The Onaway ANOVA shows a significant difference in the number of DALYs, YLLs and YLDs based on age groups.

Figure 1 illustrates the rates of YLLs and DALYs per 100,000 population attributable to CRC, disaggregated by sex, from 1995 to 2019. A marked increase in both indicators was observed in both males and females. Notably, the rate of DALYs per 100,000 population was consistently higher in males than in females throughout the entire period.

Fig.1. Rate of DALYs and YLLs per 100,000 Population for Colorectal Cancer by Gender in Iran (1995-2019)



4. Discussion

According to the GBD study, there has been a marked increase in colorectal cancer (CRC)-related epidemiological indicators in Iran between 1995 and 2019. Over this 25-year period, CRC accounted for more than 2.4 million DALYs and approximately 94,100 deaths across all age groups and both sexes. The incidence rate of CRC rose from 4.63 per 100,000 individuals in 1995–1999 to 10.85 per 100,000 in 2015–2019, while the prevalence rate increased from 19.32 to 49.45 per 100,000 individuals.

Our analysis revealed that the morbidity and mortality indicators for CRC in Iran have increased at a faster rate compared to some other countries. Specifically, CRC incidence in Iran increased approximately 2.72-fold, while the prevalence rose 3.05-fold over the study period. DALYs attributable to CRC increased 2.9-fold, and CRC-related deaths rose by a factor of 3.3. In 2019, CRC accounted for approximately 0.8% of total DALYs and 1.6% of all deaths in Iran. In contrast, DALYs attributable to CRC comprised 0.18%, 0.48%, 1.7%, and 2.0% of total DALYs in low, low-middle, high-middle, and high Sociodemographic Index (SDI) countries, respectively (4). The GBD study also reported that among 204 countries, 157 experienced a doubling or more in CRC incidence, and 129 observed at least a doubling in CRC-related mortality between 1990 and 2019 (12). Globally, CRC deaths surpassed 9.2 million by 2019, reflecting an increase of more than 109% since 1990 (13).

The greatest burden of CRC was observed in individuals aged 50–69 years, who accounted for approximately 45% of CRC-related DALYs and 38% of CRC deaths during the study period. Individuals aged 15–49 and those aged ≥70 years contributed 28% and 26% of DALYs, respectively. Notably, the highest proportion of deaths (47%) occurred in individuals aged 70 years and older. These findings are consistent with the established understanding of CRC as a disease strongly associated with aging. The risk of developing colorectal polyps—which may progress to malignancy if not detected and removed—increases substantially with age. The likelihood of adenomas advancing to colorectal cancer rises significantly after age 50, accompanied by an elevated risk of both CRC incidence and mortality (14). However, the high burden of CRC in the 50–69 age group in Iran may also reflect demographic trends, including the expansion of the middle-aged population. Prior studies have shown that 35% of the increase in CRC burden from 1990 to 2013 was attributable to population growth, while 41.9% was due to changes in age structure (15).

Our findings also revealed a significantly higher burden of CRC in men compared to women across all measured indicators, including DALYs, incidence, prevalence, and mortality. This gender disparity became more pronounced with increasing age. These results are supported by prior research indicating that women have a lower lifetime risk of developing CRC and tend to present with distinct tumor characteristics at both clinical and molecular levels (6). A meta-analysis confirmed that men have a significantly higher risk of developing advanced colorectal neoplasia and cancer, regardless of age (16). Similarly, other studies reported a higher number of CRC cases and related deaths among men compared to women up to the age of 80–84 years (12). A population-based study in China also highlighted significant gender disparities in CRC incidence (17). Several biological and behavioral factors may contribute to this disparity. Men generally have higher levels of visceral adiposity and are more likely to engage in behaviors such as smoking and alcohol consumption, all of which are associated with increased CRC risk (18). Conversely, endogenous estrogen exposure and the use of oral contraceptives in women have been shown to exert protective effects against CRC (19).

To the best of our knowledge, this study provides a comprehensive analysis of CRC epidemiological trends in Iran using GBD data spanning from 1995 to 2019. It offers important insights into the temporal evolution of CRC burden across age and sex groups, which may inform future public health strategies and resource allocation. Nevertheless, several limitations must be acknowledged. This study relied on secondary data from the GBD study, which may be subject to inherent limitations in data quality, completeness, and model-based estimations.

Colorectal cancer remains a major public health concern in Iran and globally. The predominance of YLLs in the total DALYs underscores the urgent need for effective preventive strategies, early detection, and widespread screening programs. Given the increasing burden observed in individuals aged 50–69 years, and the emerging trends in younger populations, there is a pressing need for health authorities to anticipate future CRC trends and implement age- and gender-sensitive interventions aimed at prevention, timely diagnosis, and appropriate treatment.

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Authors' contribution
Study concept and design: A F, S A. Acquisition of data: S H, A F. Analysis and interpretation of data: A F, S H, H Y, N M. Drafting of the manuscript: A F, S H, N M. Revision of the manuscript: A F, S H.

Ethics
This study was approved by the Ethics Committee of the Urmia University of Medical Sciences (IR.UMSU.REC.1402.158).

Conflict of Interests
The authors declare that they have no competing interests.

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Data Availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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