

Burden of Colorectal Cancer Mortality in Grenada: A Retrospective Observational Study from 2014 to 2023

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Abstract

Purpose

Colorectal cancer is the second leading cause of cancer-related mortality worldwide. Incidence and mortality rates are rising in the Latin American and Caribbean region, yet limited data exist on the burden of and demographic factors associated with colorectal cancer in Grenada, West Indies.

Methods

This retrospective study analyzed temporal trends and disparities in colorectal cancer by age and sex from 2014 to 2023. Joinpoint regression evaluated temporal trends in mortality, and negative binomial regression assessed the relationship between mortality rates and predictor variables (age and sex).

Results

The results showed no significant temporal trend in mortality rates over the study period (Annual Percent Change [APC] = -2.19%; $p = 0.614$). Sex was not significantly associated with the death rate (Mortality Rate Ratio [MRR] = 0.92; $p = 0.62$). However, age was significantly associated with higher death rates from age 50 onward. The highest mortality rates were observed among individuals aged 60–69 years (MRR: 8.2; $p < 0.001$), 70–79 years (MRR: 7.8; $p < 0.001$), and 80–89 years (MRR: 6.8; $p < 0.001$).

Conclusion

These findings underscore the critical need to prioritize screening and early diagnosis among older populations to improve treatment outcomes. Further research on modifiable risk factors remains essential to inform targeted public health interventions.

Introduction

Colorectal cancer (CRC) is a major contributor to the global cancer burden, ranking as the third most diagnosed cancer and the second leading cause of cancer-related mortality worldwide (1, 2). With an estimated 904,000 deaths in 2022, it accounts for approximately 10% of all cancer cases and deaths globally, underscoring it as a significant public health priority (1, 2). The five-year survival outcome varies across regions, averaging 60% in high-income countries relative to often below 50% in lower-income countries, highlighting the disparity in outcomes (3).

Colorectal cancer has been strongly associated with age, with a marked increase in incidence and mortality over 50 years of age (4). There has also been a higher incidence and mortality globally observed in males, 45% and 50% higher, respectively, in contrast to females (5). Epidemiological

evidence consistently identifies key factors associated with colorectal cancer as high intake of processed meats, low intake of fruits and vegetables, physical inactivity, obesity, smoking, and alcohol consumption (1, 6). In recent years, transitioning countries have also seen a steady rise in colorectal cancer incidence rates, largely due to dietary changes and an increasingly sedentary lifestyle (2).

In the Latin American and Caribbean region (LAC), colorectal cancer has the third highest incidence and deaths among all cancers, seeing a 20.5% increase in mortality between 1990 and 2019 (7, 8). Predictions up to the year 2035 suggest this continued rise in colorectal cancer incidence and mortality, in contrast to other regions (9). This study focuses on Grenada, a Caribbean island nation in the West Indies with a population of 125,759 (10). Grenada's age-adjusted mortality rate from colorectal cancer was 16.2 per 100,000 in 2019 in men and 13.7 per 100,000 in women (11). An increasing burden of obesity, a known strong risk factor associated with CRC, is also seen in Grenada, with a prevalence of 59.99% among people aged 15 and older in 2022 (11).

Despite advancements in screening and treatment plans that have improved outcomes in certain regions, disparities in access to early detection and care continue to influence mortality patterns across Caribbean populations. Given the importance of understanding population-specific cancer patterns, this study evaluates temporal trends in colorectal cancer mortality rates in Grenada from 2014 to 2023 using national mortality data obtained from the Ministry of Health. By generating locally relevant evidence, this retrospective study aims to support public health planning, strengthen cancer surveillance systems, and support targeted interventions to reduce colorectal cancer mortality in Grenada, West Indies.

Methods

Study design

This study employed a retrospective observational design to analyze mortality trends for colorectal cancer in Grenada over 10 years. The retrospective approach was selected as it allows for the efficient examination of existing mortality data to identify temporal patterns and associations with demographic factors.

Data source

Mortality data were obtained from the Ministry of Health, Grenada, which serves as the central repository for all vital statistics and cause-specific mortality records in the country. The Ministry maintains comprehensive death registration data, including cause of death certification by medical practitioners, in accordance with International Classification of Diseases (ICD) coding standards.

Study period

The study covered a 10-year period from January 1, 2014, to December 31, 2023. This timeframe was selected to provide a contemporary assessment of cancer mortality trends while allowing for sufficient annual observations to conduct robust statistical analyses.

Data analysis

Descriptive statistics were calculated and presented in the form of table and charts to characterize the study population, including sex distribution, age group, annual mortality counts, and crude mortality rate. Negative binomial regression was employed to determine the relationship between mortality rates and predictor variables. Joinpoint regression was used to evaluate the temporal trend in mortality from 2013 to 2024. The analyses were performed using R programming software with a significance level set at 5% and 95% confidence interval.

Results

Sex Distribution of Mortality

A total of 150 colorectal cancer deaths were recorded in Grenada between 2014 and 2023. Males accounted for 72 (48%) and females for 78 (52%) of total deaths. There was no consistent pattern of sex predominance. Male deaths were greater in 2016, 2017, 2021, and 2022, while female deaths were higher in 2015, 2018, 2019, and 2020. Male mortality peaked in 2017 and 2021 at 12%, compared to female mortality in 2015, 2020, and 2021 at 10%. (Fig. 1). Both male and female mortality rates fell to 6% after peaking in 2021. Overall, mortality was similarly distributed between males and females.

Age- Specific Mortality

Mortality rates from colorectal cancer increased with age, peaking at age 60–69 years (27.5%). Mortality rates slightly declined at age 70–79 years (26%) and further decreased in individuals aged 80 years and older to 22.7% (Fig. 2). Approximately 76% (n = 114) of all colorectal deaths occurred in individuals over 60 years. Deaths among individuals aged < 40 years were rare, accounting for only 3.3% (n = 5) of all cases (Fig. 2).

Temporal Trends in Colorectal Cancer Mortality

Grenada had 150 total deaths from colorectal cancer between 2014 and 2023 (Fig. 1), during which population size remained relatively stable. Crude mortality rates ranged from 8.6 to 18.9 per 100,000 people, with both the highest number of deaths and the highest rate observed in 2021. The highest mortality rate (2021) was 18.9 per 100,000, whereas the lowest rates occurred in 2018 and 2019, both at 8.6 per 100,000 (Fig. 3).

Substantial year-to-year variability in mortality rates was observed over the study period. Mortality rates declined from 15.8 per 100,000 in 2014 to 11.3 per 100,000 in 2016, increased to 18.2 per 100,000 in 2017, declined to 8.6 per 100,000 in 2019, rose again to 18.9 per 100,000 by 2021, and decreased to 10.2 per 100,000 by 2023 (Fig. 3).

Association of colorectal cancer with sex and age group

Negative binomial regression showed no significant relationship between colorectal cancer mortality and sex ($p = 0.6891$, MRR = 0.9163, 95% CI: 0.6477–1.2946). However, age was seen to be significantly associated with cancer mortality. Compared to persons less than 40 years of age, colorectal cancer mortality rates were significantly higher among individuals 50–59 years ($p = 0.0024$; MRR = 4.6; 95%CI: 1.8536–13.9123), 60–69 years ($p < 0.0001$; MRR = 8.2; 95% CI: 3.4829–24.1842), 70–79 years ($p = 0.0001$; MRR = 7.8; 95% CI: 3.2914–22.9701), and 80 years and older ($p = 0.0001$; MRR = 6.8; 95% CI: 2.8368–20.1088) (Table 3).

Table 1
Regression Analysis for the association between colorectal cancer mortality with age and sex

Variable	Level	Count	p value	MRR	95% CI, lower	95% CI, upper
Gender	Female	78	Ref	NA	NA	NA
	Male	72	0.620	0.9163	0.6477	1.2946
Age Group	< 40 yrs	5	Ref	NA	NA	NA
	40–49 yrs	8	0.418	1.5984	0.5241	5.3687
	50–59 yrs	23	0.002	4.6006	1.8536	13.9123
	60–69 yrs	41	< 0.001	8.2199	3.4829	24.1842
	70–79 yrs	39	< 0.001	7.7933	3.2914	22.9701
	80 yrs plus	34	< 0.001	6.7849	2.8368	20.1088
MRR: Mortality rate ratio						

Trend analysis

Joinpoint regression analysis identified a single segment from 2014 to 2023, with an annual percent change (APC) of -2.19% (95% CI: -13.49 to 10.22; $p = 0.614$). The trend was not statistically significant, indicating no evidence of a sustained increase or decrease in colorectal cancer mortality over the study period (Fig. 4).

Table 2
Joinpoint regression analysis for colorectal cancer mortality in Grenada between 2014 and 2023.

Segment	Lower Endpoint	Upper Endpoint	APC	Lower CI	Upper CI	P-Value
1	2014	2023	-2.1892	-13.4926	10.2163	0.6143

Discussion

This is the first study to provide an in-depth analysis of colorectal cancer mortality patterns in Grenada over a 10-year period. In Latin America and the Caribbean, colorectal cancer mortality is projected to double by 2035 due to population aging and increasing exposure to risk factors (9). This broader regional burden is observed in our findings.

Colorectal cancer burden is closely linked to a country's level of socioeconomic development (9, 12). In higher Human Development Index (HDI) nations, incidence increased due to greater exposure to modifiable risk factors, while mortality rates declined because of improved screening and treatment access (9, 12). In our results, Grenada's crude mortality rates ranged between 8.6 and 18.9 per 100,000 population between 2014 and 2023. According to GLOBOCAN 2022, the average age-standardized mortality rate (ASMR) for the Caribbean was 9.3 per 100,000, while high-HDI countries reported an ASMR of 8.3 per 100,000 (11, 13). This comparison between age-standardized rates and crude mortality rates should be interpreted with caution, as both are not comparable due to differences in population age structures. Crude mortality rates show the burden of colorectal cancer deaths and can be used for national health planning in small islands where population size is limited. A prior regional analysis between 2007 and 2013 that compared Grenada with six English-speaking Caribbean countries (Barbados, Bahamas, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, and Trinidad and Tobago) found that Grenada had slightly lower age-adjusted colorectal cancer mortality than the Caribbean average (RR: 0.93, $p = 0.66$), although this difference was not statistically significant (14). In the same study, comparisons between 2000–2009 and 2007–2013 showed a concerning trend within Grenada, where colorectal cancer mortality nearly doubled among females ($p = 0.018$) and showed a prominent but statistically non-significant increase of 62% among males ($p = 0.068$) (14). These findings suggest that Grenada's colorectal cancer mortality burden is comparable to that of its neighbouring Caribbean countries, thus highlighting the need for improved cancer prevention, screening and treatment services within the region.

There was no significant difference in colorectal cancer mortality between males and females in Grenada during the study period (MRR: 0.92; $p = 0.62$). This contrasts with the global and Caribbean averages, where males had higher mortality rates (globally, age-standardized mortality rates are approximately 9.9 per 100,000 in males and 6.5 per 100,000 in females, while Caribbean rates are 10.9 and 8.0 per 100,000, respectively) (13, 15). The absence of a sex difference in our findings may reflect the small sample size of the studied cohort. Another possible explanation is that in Grenada, shared exposure to lifestyle-related risk factors may contribute to similar risk profiles between males and females, while the absence of a national screening program may lead to delayed diagnosis in both sexes, potentially contributing to comparable mortality rates (16). These interpretations should be taken with caution until larger cohorts are studied.

Within the study, mortality was almost five times greater in the 50–59 age group (MRR: 4.60; 95% CI: 1.85 to 13.91) and approximately eight times higher in both the 60–69 (MRR: 8.20; 95% CI: 3.48 to 24.18) and 70–79 age groups (MRR: 7.80; 95% CI: 3.29 to 22.97) compared to individuals under 40 years. Our results are consistent with global patterns demonstrating a substantial increase in colorectal cancer

mortality after 50 years of age (17). Similar trends are seen in the United States, where increases in cancer incidence and mortality are seen in those above 50 years and older (18). Higher mortality among older populations is likely attributable to the cumulative effect of colorectal cancer risk factors, higher burden of comorbid conditions, and reduced tolerance to intensive cancer therapies, all of which may negatively affect treatment outcomes and survival (19). These findings support the initiation of screening and prevention strategies before the increase in mortality observed after age 50.

In Grenada, colorectal cancer mortality was stable between 2014 and 2023, as joinpoint regression analysis indicated no significant temporal trend (APC: -2.19% ; $p = 0.61$). The wide confidence intervals (-13.5 to 10.2) in joinpoint analysis showed the expected variability in small island populations, where few deaths can create large fluctuations in annual mortality rates (20). Despite the fluctuations, our analysis depicted no increase or decrease in mortality in the 10-year period. In contrast, high-income countries in North America and Europe demonstrated steady declining rates of colorectal cancer mortality due to increased screening and treatment access, whereas countries in Latin America and the Caribbean stand out as exceptions where mortality rates are projected to increase with aging population and gaps in healthcare delivery (9, 21). This suggests that Grenada is undergoing an important transition, defined by increasing exposure to westernized lifestyle risk factors that is not yet matched by the local healthcare system's ability to provide screening and treatment services. While mortality trends appeared stable, the absence of a national cancer registry limits assessment of incidence patterns, which may be increasing alongside Grenada's rising burden of metabolic risk factors (22).

Modifiable risk factors including obesity, diabetes, physical inactivity, tobacco use, alcohol consumption, and diets high in ultra-processed foods increase risk of colorectal cancer mortality (9, 12, 23–28). Recent WHO and PAHO reports show that approximately 30% of Grenada's adult population and 19% of children and adolescents were classified as obese, while nearly one-third of the population reported insufficient physical activity (11, 29). According to WHO, Diabetes was among the leading causes of death in 2021, indicating the rising local burden of noncommunicable diseases (29). In the latest data, tobacco and alcohol use contributed to 12% and 8% of cancer-related deaths, respectively (16). Barbados, another Caribbean small island developing state (SIDS) provides insight into local dietary patterns, where it derives nearly 40% of dietary energy from ultra-processed foods, reflecting nutritional transitions occurring across the region (30, 31). Grenada is likely undergoing similar dietary changes; however, local nutritional and dietary data are limited. The incomplete implementation of tobacco control policies in Grenada represents a missed opportunity, and policy interventions targeting diet and physical activity are urgently needed (32).

Early detection remains the most effective strategy for lowering colorectal cancer mortality. Current US Preventive Services Task Force (USPSTF) guidelines recommend initiating screening at age 45 (33). Observational and randomized trial evidence has demonstrated that screening colonoscopy can reduce mortality by up to 50% to 68% depending on screening adherence (34, 35). As of 2019, Grenada still lacks an organized screening program and national early detection guidelines which likely contributes to late-stage presentation and higher mortality (16). Barriers to screening in Caribbean settings include

affordability, limited awareness, restricted access to services, and cultural perceptions toward screening, all of which might contribute to delayed diagnosis and poor outcomes (36). Fecal immunochemical testing (FIT), a cost-effective and non-invasive approach supported by referral pathways for diagnostic colonoscopy, may represent a feasible strategy for SIDS (37). This is important given that Grenada only spent 2.22% of its GDP on public health in 2021, with approximately 54% of healthcare costs paid out-of-pocket (11).

Limitations

Grenada's small population can lead to variability in annual mortality rates, resulting in wide confidence intervals and contributing to the non-significant temporal trends observed in the joinpoint regression analysis. Additionally, due to the absence of incidence, staging, and treatment data, observation of the differences between disease prevalence versus survival outcomes could not be understood. Focus on secondary mortality data could have been affected by inaccuracies or misclassification of cause of death reporting, leading to underestimation of the true mortality burden. This is mostly evident in areas with limited healthcare resources. Modifiable risk factors such as tobacco and alcohol use, body mass index, dietary intake, and screening history were not recorded, preventing study of effects relating to incidence and mortality.

Conclusion

In this national analysis of colorectal cancer mortality in Grenada, no significant temporal trend was observed between 2014 and 2023, despite variability in annual rates. Mortality increased significantly with age, particularly among individuals aged 50 years and older, while no significant association was observed for sex. In contrast to higher-resource settings, mortality has not shown a consistent decline over time. This may reflect gaps in early detection, screening, and access to care. These findings underscore the importance of prioritizing screening among older populations and strengthening cancer surveillance to support earlier diagnosis and improved outcomes. Future studies should examine healthcare access, screening rates and methods, and modifiable risk factors to guide interventions in Grenada and similar small island states. Additionally, longitudinal studies consisting of larger sample sizes that incorporate data on cancer stage at diagnosis and treatment modalities are needed to better understand factors influencing mortality and disease outcomes.

Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Yusuf Yakubu and Lindonne Telesford. The first draft of the manuscript was written by Tamara Slavkovska, Mikayla Williams, and Urvashi Thongam. Jevonie Thomas, Divya Thangella, Chigozirim Okpechi, and Katerina Nozhenko reviewed and edited the previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability

The datasets generated during and/or analysed during the current study are available in the Zenodo repository at DOI: 10.5281/zenodo.22258284 (<https://zenodo.org/records/22258285>).

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Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors employed Grammarly and Copilot AI to enhance clarity, grammar, phrasing, and concision of the initial draft. Following the use of these tools, all authors critically reviewed and edited the manuscript, and they accept full responsibility for the content and conclusions of the published article.

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Figures

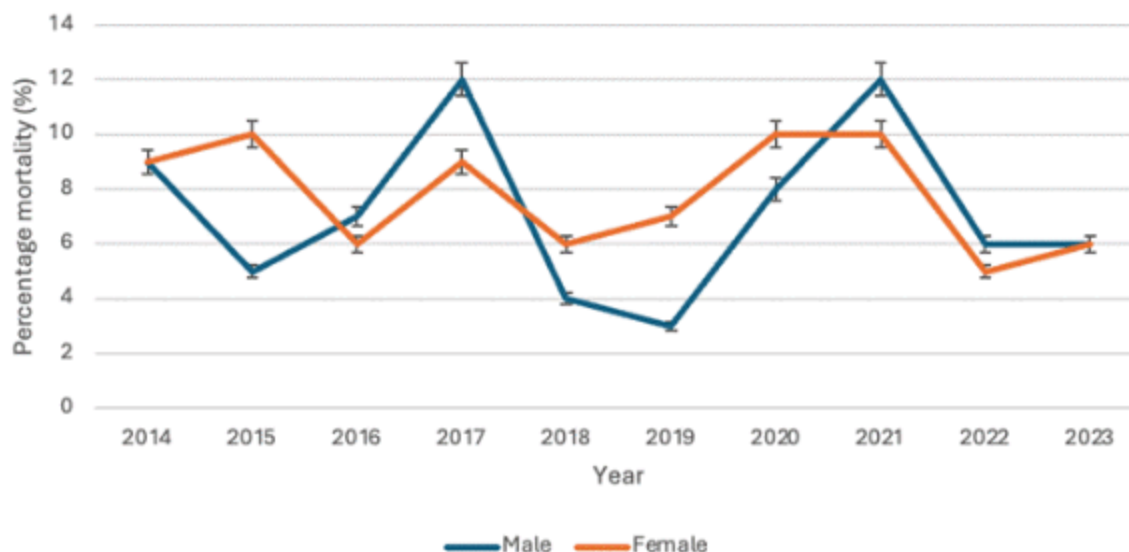


Figure 1

Temporal Trends in Colorectal Cancer Mortality (%) by Sex in Grenada, 2014–2023

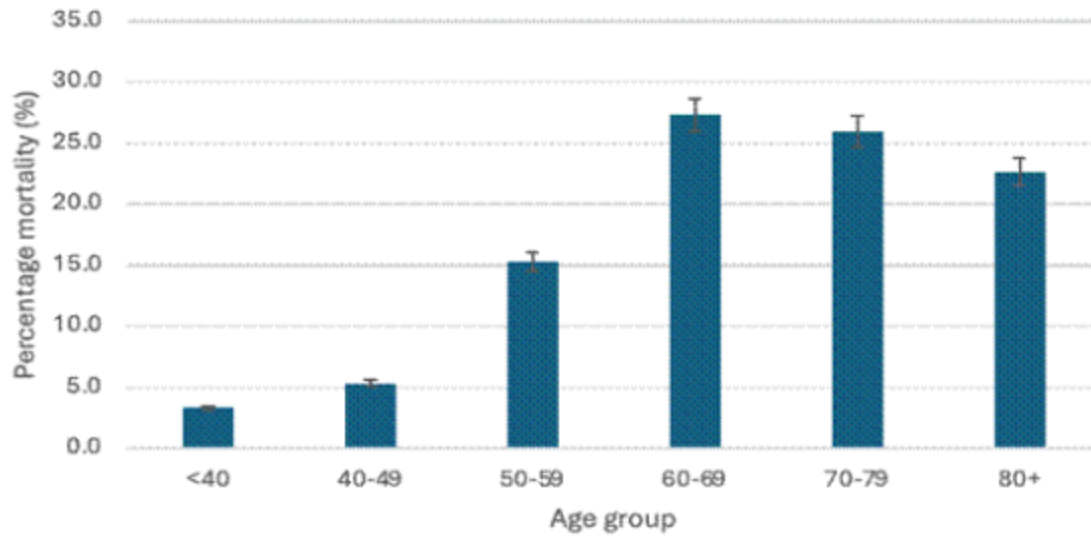


Figure 2

Age Distribution of Colorectal Cancer Mortality (%) in Grenada

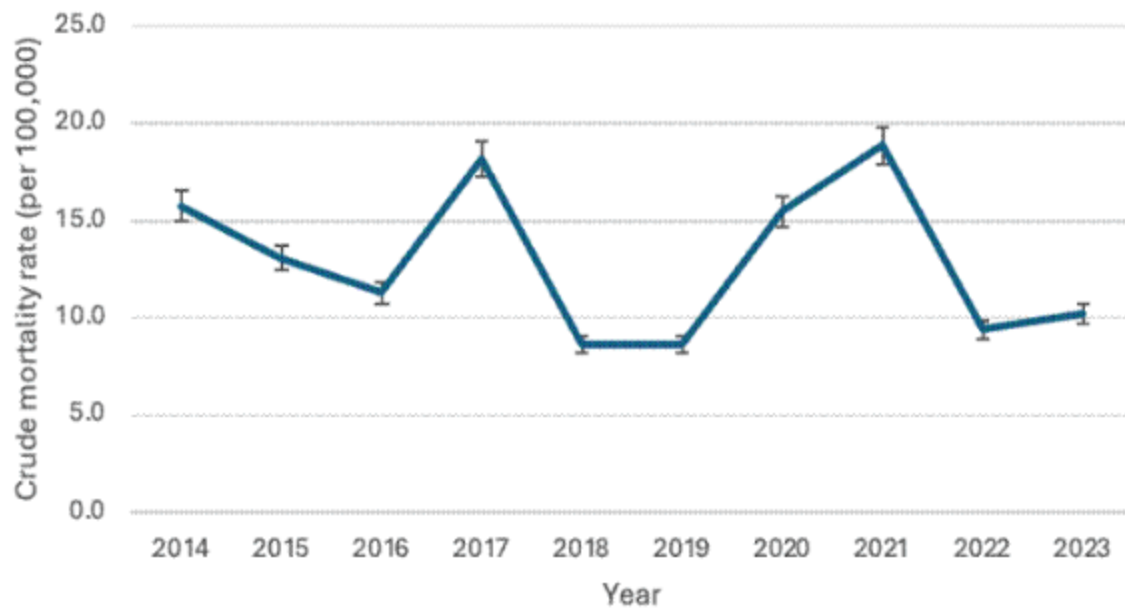


Figure 3

Colorectal cancer crude mortality in Grenada from 2014 to 2023

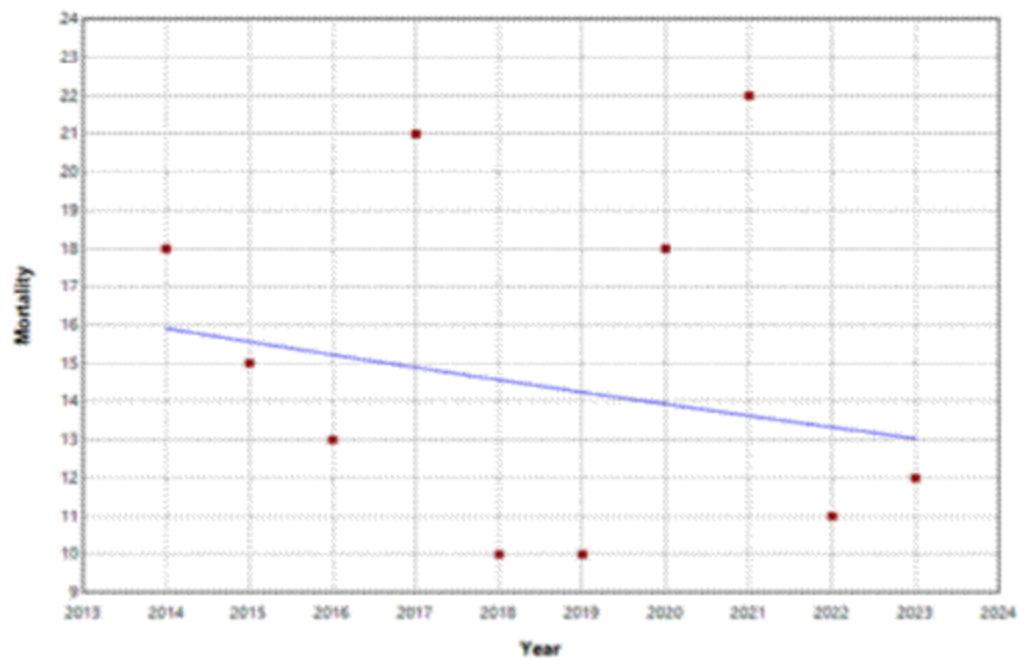


Figure 4

Colorectal cancer crude mortality in Grenada from 2014 to 2023