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Incidence, trends and patterns of female breast, cervical, colorectal and prostate cancers in Antigua and Barbuda, 2017–2021: a retrospective study

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Abstract

Background Globally, estimates of cancer cases and deaths have increased since 2018, particularly in Latin America and Caribbean countries. In Antigua and Barbuda, understanding the burden of common cancers such as female breast, cervical, colorectal and prostate cancers is critical. This study aimed to assess the incidence, trends, and patterns of these four cancers from 2017 to 2021.

Methods Using a retrospective observational study design, information on these cancers was abstracted from medical records at four key study sites in Antigua and Barbuda. Estimates of age-specific and age-standardized incidence were determined using direct standardization. The KeyFitz method was used to derive standard errors and confidence intervals. Derived estimates were employed to analyze trends and Joinpoint regression modeling was used to determine annual percentage change.

Results Between 2017 and 2021, 391 cases of female breast (41.7%), cervical (10.2%), colorectal (20.2%) and prostate (27.9%) cancers were diagnosed. Overall mean age at presentation was 61.5 (± 12.9) years, ranging from 24 to 94 years, age-standardized incidence rate 65.2 (95% CI: 58.7–71.6) per 100,000 population. Age-standardized incidence rate for female breast cancer was 49.9 (95% CI: 42.2–57.8), annual percentage change in incidence a low of -0.2%. Prostate cancer had the second highest age-standardized incidence rate at 41.6 (95% CI: 33.8–49.4), annual percentage change showed a gradual but steady increase at 21.7%. Per cancer types, variations in age-standardized incidence rates were noted across age-groups, year-of-presentation, and parishes. Collectively, there was an 8.1% (95% CI: -14.9–37.6) annual percentage change increase in age-standardized incidence rates between 2017 and 2021. Incident cases, age-standardized incidence rates, and trends per cancer type are expected to gradually increase during 2022–2030 (average annual percentage increase is 3.4%).

Conclusions This study is a first step in providing reasonable evidence on the incidence, trends, and patterns of four common cancers in Antigua and Barbuda. Female breast and prostate cancers were the dominant cancer types in

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terms of incidence, age-standardized incidence and predicted increasing incidence trends. Variableness in cancer-specific age-standardized rates across parishes and years of presentation were observed. Besides research, this study has importance for instituting cancer prevention and control measures, including surveillance and healthy lifestyles initiatives.

Keywords Antigua and Barbuda, Cancer, Incidence, Trends, Patterns

Background

The burden of cancer represents a significant public health challenge that is increasing in every country due to population growth and aging [1–5]. It represents a barrier to increasing life expectancy in several countries where it is easily the first to fourth leading cause of death before the age of 70 years [2]. Global estimates suggest that there were 19.3 million new cancer cases and approximately 10 million cancer-related deaths in 2020 [2, 6], a slight increase from 2018 estimates of 18.1 million new cases and 9.6 million cancer-related deaths [4]. Here the age-standardized incidence for both sexes was 201.0 per 100,000 and 186.0 and 201.0 per 100,000 for men and women, respectively [4]. In the same year, the age-standardized mortality rate was 100.7 per 100,000 for both sexes and 120.8 and 84.2 per 100,000 for men and women, respectively, highlighting the increasing burden that cancer incidence and mortality impose on all countries, especially in low and low-middle-income countries (LMICs) such as those in Latin America and the Caribbean [2, 7], where they accounted for 47% of the 1.2 million deaths in 2008 [8] and an estimated 4 million newly diagnosed cases and 1.4 million deaths in 2020 [8].

The International Agency for Research on Cancer (IARC) in its 2020 GLOBOCAN report on incidence and mortality, suggested that female breast cancer (11.7% and 6.9%), colorectal cancer (10.0% and 9.4%) and prostate cancer (7.3% and 3.8%) are among the five most common cancers affecting several countries, while cervical cancer (3.1% and 3.4%) is one of the ten most common cancers described based on new cases and deaths [9]. In 2020, these four cancers accounted for an estimated 32% of cancer incidence and 23% of cancer-related deaths worldwide [9], thereby contributing to (i) major challenges for health systems given their demand for effective preventive measures such as vaccinations, improved screening and diagnostic tools, and advances in therapeutic care [7], as well as (ii) the trend observed in developed countries, where colorectal cancer is the leading cause of cancer death in both sexes, followed by prostate cancer in men and breast cancer in women [2, 7]. In less developed countries, prostate and colon cancers are the most common in men, while colon, breast and cervical cancers are the most common in women [2, 7]. Collectively, and over time, if not addressed, these four cancers could worsen poverty among vulnerable groups in countries such as Antigua and Barbuda [10, 11].

In Antigua and Barbuda alone, cancer accounted for 21% of the estimated 82% of NCD deaths in 2020 [8]. Simon et al.. 2014 showed that between 2001 and 2005, 15% of deaths in Antigua and Barbuda were due to cancer, compared to 11% in the period from 1984 to 1989 [12–14]. Similarly, Simon et al.. 2014 reported that of the 492 histologically confirmed new cases of cancer in the five-year period 2001–2005, those with some of the highest incidence rates were prostate cancer (69.0 per 100,000), female breast cancer (37.6 per 100,000), cervical cancer (23.1 per 100,000) and colorectal cancer (10.8 per 100,000) [13]. Findings which make understanding the changing extent and profile of these diseases critical to developing prioritized interventions at the national level [13, 15]. Except for the recent publications by Rhudd in 2021 and Simon et al. in 2014, there is a scarcity of data and limited research on the present incidence, trends, and patterns of cancer in Antigua and Barbuda [13, 15]. Addressing the current gaps in understanding the epidemiological burden of these four cancers is critical. Therefore, this study aimed to investigate the incidence, trends and patterns of breast (female), cervical, colorectal, and prostate cancers in the population of Antigua and Barbuda from 2017 to 2021.

Materials and methods

Study design and setting

This was a retrospective observational study of histologically confirmed cases of men and women, aged 18 years and older who were diagnosed with a primary tumour of the breast, cervix, colorectum, as well as histologically confirmed cases of prostate cancer in men, from 2017 to 2021.

In the absence of a functional national cancer registry, study data were obtained by record abstraction using patient files held primarily at the Oncology, Pathology and Urology departments of the Sir Lester Bird Medical Centre (SLBMC), the Cancer Centre Eastern Caribbean (TCCEC), and the Medical Benefits Scheme (MBS). Data on cancer deaths were obtained from the Ministry of Health, Health Information Division. All these establishments are in St. John's, Antigua and Barbuda.

The exclusive provider of public tertiary care for cancer diagnosis and management, as well as the primary facility for evaluating a significant portion of pathological samples in Antigua and Barbuda, is the Sir Lester Bird Medical Centre (SLBMC) [17]. The Medical Benefits

Scheme (MBS), operating under the Ministry of Health in Antigua and Barbuda, is a statutory body. This entity extends pharmaceutical care and financial aid to individuals diagnosed with cancer or other specific chronic diseases on the island who are registered beneficiaries with the organization. The Cancer Centre Eastern Caribbean (TCCEC), on the other hand, is a public-private partnership, that, in addition to providing cancer diagnostic and management services to paying customers, also offers the administration of radiation therapy to persons diagnosed with a select number of cancers on the island.

Study population

The study population comprised persons living in Antigua and Barbuda who were diagnosed with one of the four cancers-female breast, cervical, colorectal and prostate-in Antigua and Barbuda from January 2017 to December 2021. Cases with recurrent cancer, and a lone case of male breast cancer, were excluded from the study population given the potential for their inclusion to yield unreliable estimates.

Data acquisition

Data were abstracted in two stages. First, cases were identified from the medical records of persons diagnosed with each cancer type in accordance with the World Health Organization (WHO) classification for histologic type of tumour, whose condition was coded based on the International Classification of Diseases Tenth Edition (ICD-10) [16], and were registered with either the Oncology Department of the Sir Lester Bird Medical Centre (SLBMC) or the Cancer Centre Eastern Caribbean, Antigua and Barbuda.

In the second stage, cases were identified from the medical records held in the Pathology Department of the Sir Lester Bird Medical Centre (SLBMC) where histologically confirmed cases were diagnosed using the American Joint Committee on Cancer Classification Eight Edition Staging Manual (AJCC 8th Ed) [17]. Where appropriate, this information was cross-linked to earlier data abstracted from the first stage using a unique but corresponding identifier. Supplemental data on prostate cancer cases not otherwise contained in the Oncology and Pathology departments of the Sir Lester Bird Medical Centre (SLBMC), were obtained from the Urology Department to address obvious prostate cancer data gaps. Added data on all cancer cases were obtained from the Medical Benefits Scheme Pharmacy.

Data on the deaths of cases observed in the study period were obtained from the Ministry of Health, Health Information Division, Antigua and Barbuda. Population estimates by age group and gender for 2017 to 2021, and derived projected population estimates for 2027 to 2030, were obtained from the online report of the Statistics Division of the Ministry of Finance and Corporate Governance, Antigua and Barbuda on the population of Antigua and Barbuda from 1991 to 2026 [18]. Derived projected population estimates were ascertained on the assumption that the rate of population growth remained constant over the period 1991 to 2030 [18] (R. Anthony, Statistics Division, Ministry of Finance and Corporate Governance, Antigua and Barbuda, personal communication, August 15, 2023).

Variables and data preparation

Based on access rights and using a pretested, predesigned paper-based data collection form, cancer-specific data for each case were abstracted from paper-based textual medical records at the Sir Lester Bird Medical Centre (SLBMC), paper-based textual and electronic records at the Medical Benefits Scheme, electronic records at the Cancer Centre Eastern Caribbean (TCCEC), and the Health Information Division, Ministry of Health. Aggregate and cancer-specific data were collected and assessed for baseline characteristics under three broad headings, namely, demographic characteristics, which included age at diagnosis, age in categories, sex, parish (area of residence), year of presentation, vital status, and year of death; clinicopathological characteristics, which included cancer type, and evidence of noncommunicable disease; and socioeconomic characteristics, which included employment status at presentation. De-identified and anonymized data were then entered and stored in an EpiData 3.7 database (The Epi Data Association Odense, Denmark) on a password secured computer system for cleaning and analysis.

Data management

Data on the malignant cases of the four cancers, described by their individual sites (with disease subtypes) and defined by their International Classification of Diseases, 10th version (ICD-10) codes [19], namely, C50-breast, C53.9-cervical cancer, C18/C20 -colon and rectal cancer, and C61-prostate cancer were abstracted from records examined at the Sir Lester Bird Medical Centre and the Eastern Caribbean Cancer Centre, respectively. For ease of examination and analyses of the baseline characteristics of these cancers, age was classified as both a continuous variable and in 15-year age categories of, 20–34 years, 35–54 years, 55–74 years and ≥ 75 years; sex was defined as male and female; parish (area of residence) was defined according to Antigua and Barbuda existing geographical boundaries into Barbuda, St. George, St. John, St Mary, St. Paul, St. Peter and St. Phillip; cancer type was defined based on the four cancer types under study; vital status was categorized into alive and died; clinical stage was categorized into broad categories such as stage 1, stage 2, stage 3, stage 4 and not stated;

histological grade was presented as grade 1 (well differentiated), grade 2 (moderately differentiated), and grade 3 (poorly differentiated); evidence of noncommunicable disease was defined dichotomously as no and yes; year of presentation/diagnosis/seen was presented as per the years of the study period 2017 to 2021; employment sector was presented in three categories private, public and retired.

Outcomes ascertained

The primary outcomes determined were cancer-combined and cancer-specific incidence rates defined by age categories, parish (area of residence), year of diagnosis/presentation, and cancer subtype as well as cancer-specific age-standardized incidence rates (ASIRs) for the periods 2017 to 2021 and 2022 to 2030.

Data analysis

To investigate and understand the distribution of the data, descriptive statistics were adopted, and summary statistics (mean, range, and 95% CIs) were generated for the continuous variable age. Categorical variables are presented as frequencies and percentages.

In deriving the incidence rates, the midyear population for each year in the study period, broken down by 5-year age groups, was calculated by averaging the total population on the first and last days of a given year.

This was then aggregated to determine the midyear population at risk for that year.

Midyear Population for each selected 5-year age group per year (Mi) = $\frac{(J_P+Dp)}{2}$

Mi is midyear population at risk for each selected 5-year age group.

Jp is the population on the first day of year for selected 5-year age group.

Dp is the population on the last day of year for selected 5-year age group.

MP = Σ(Mi).

MP is the total population at risk or aggregate value of midyear population for all sixteen 5-year age groups per given year.

Age-specific, parish-specific, year of presentation/diagnosis-specific, cancer-specific and cancer subtype-specific incidence rates were then ascertained and presented. Using Microsoft Excel, crude estimates of incidence rates per 100,000 persons of population were calculated by dividing the number of incident cases by the number of persons in the Antigua and Barbuda midyear population at risk and multiplying the results by 100,000 [20] (e.g., for prostate cancer this was males; colorectal cancer males and females combined) [21]. Age-specific or stratified incidence rates in 16 age groups (0–4 years, 5–9 years,…60–64 years,…75 years and older) were also calculated [20]. Age-standardized incidence rates (ASIRs) and corresponding 95% confidence intervals (Cis) were determined using the direct standardization method [20] and involved use of the Segi World Standard Population [22]. Poisson exact confidence intervals were calculated for crude incidence rates and crude age-stratified incidence rates [20].

In the absence of midyear population estimates disaggregated by 5-year age groups, the projected age- standardized cancer-specific incidence rates for 2022 to 2030 were determined, first, by using the annual population projections by 5-year age-group and gender for 1991 to 2026, as reported by the Statistic Division, Ministry of Finance and Corporate Governance, Antigua and Barbuda, to obtain the corresponding midyear projected populations. Midyear projected population estimates for 2027 to 2030 were derived on the assumption that the rate of population growth remained constant over the period 1991 to 2030 [18] (R. Anthony, Statistics Division, Ministry of Finance and Corporate Governance, Antigua and Barbuda, personal communication, August 15, 2023). A simple linear regression model, utilizing a priori determined 2017 to 2021 cancer-specific incident cases, and corresponding projected estimates of midyear populations was then used to obtain the cancer-specific incident cases for 2022 to 2030 [23]. The resulting cases were disaggregated according to 5-year age groups and based on the distribution of cases for the known period 2017–2021. This information was then entered into an Excel spreadsheet based on the Keyfitz method [24] and used to derive projected crude and age-standardized cancer-specific incidence rates using the Segi World Standard population under the direct method.

Trend analysis was carried out using regression modelling [24–26]. A Joinpoint regression model was used to investigate the percentage change over time among the four cancers. The standard error, confidence intervals, age specific rates and incidence rate with projected population estimates were calculated using Excel. The overall incidence rates, CIs and standard errors were imported into the Joinpoint program. Given limitations in the number of data points, Joinpoint models for each cancer type was based on Weighted Bayesian Information Criterion (WBIC) because of its computational efficiency, the parametric method and a maximum of 1 Joinpoint [24].

All analyses were conducted using Microsoft Excel, the STATA 17/SE-Standard Edition (Statistical Corporation, College Station, Texas, USA) statistical package and the Joinpoint Regression Program, Version 5.0.2 (Statistical Research and Applications Branch, National Cancer Institute).

Ethical considerations
Approval for this study was granted by the Antigua and Barbuda Institutional Review Board, Ministry of Health (AL-04/052022-ANUIRB), the Institutional Review Board of the Sir Lester Bird Medical Centre and the University of KwaZulu-Natal Biomedical Research Ethics Committee (BREC/00004531/2022).

This study did not involve direct contact with cases and there was no direct risk to persons [27]. De-identification and anonymization was ensured by not recording the names of the patients [27].

Results
Descriptive statistics
All four cancer types
During the 2017–2021 period, a combined total of 391 cases were diagnosed with one of the four cancers under study (Table 1). For the common baseline characteristics examined, the mean age at diagnosis/presentation was 61.5 (± 12.9) years, with a minimum age of 24 years and a maximum age of 94 years (Table 1). Of the defined age-categories, 20–34, 35–54, 55–74 and ≥ 75years, age-group 55–74 years accounted for 58% of the cases, while age-group 35–54, the second largest group, accounted for 24% (Table 1). Among the cases identified, female-specific cancers (breast and cervical cancers) accounted for 52% of cases, while the male-specific cancer (prostate cancer) accounted for 28%. Colorectal cancer, which is common to both males and females, accounted for approximately 20% of the cases (Table 1). Overall, the dominant cancer types were female breast cancer (41.7%) and prostate cancer (27.9%), with the least dominant being cervical cancer (10%) (Table 1).

Across years of presentation, and except for female breast cancer in 2018 with 55% of the case count, the year 2020 accounted for the largest number of both cancer-specific cases diagnosed/presented (Table 1). By parish, St. John, being the most populous area or residence, accounted for 56% of all cases (Table 1) (see Additional file 1), with the second most populous region, St. George, accounting for 16% of cases. Each of the remaining parishes contributed under 10% of cases to the case count, respectively (Table 1).

Female breast cancer
For the 163 female breast cancer cases identified, mean age at presentation/diagnosis was 58.7 (± 13.5) (95% CI: 56.6–60.8) years, and range 24 to 94 years. The age category 55–74 years accounted for most of the cases (53.0%), whereas the age category 20–24 had the least number of cases (5.0%) (Table 1). The parishes of St. John, St. George and St. Mary combined accounted for 77% of all cases. Barbuda did not contribute any cases to the count. The number of cases ranged from a low of 16% in 2017 to a high of 22% in 2018 (Table 1). The results showed a vast disparity in the morphological description of cases with 96% deemed 'invasive' disease, and approximately 4% were considered *'in situ'* disease (Table 1).

With respect to disease stage at diagnosis, 36% of cases had stage 2 disease, 23% had stage 3 disease and approximately 20% had stage 4 disease (Table 1). Disease stage for about 7% of cases was not given.

Of the histologic grades presented, grade 1 (well differentiated) and grade 2 (moderately differentiated) (69%,) were the dominant disease grades among the cases. The histological grades of 21% of the cases were not stated (Table 1).

Cervical cancer
For the forty (40) cases of cervical cancer identified, the mean (± SD) age at presentation/diagnosis was 51.8 (± 15.0) years (95% CI: 47.0–56.6), and the age range was 30 to 86 years (Table 1). In contrast to female breast cancer cases, 50% of cases were between the ages of 35 and 54 years. Moreover, 80% of cases were between the ages 30 and 60 years, with only 20% of cases above 60 years. No parish was untouched by cases, with St. John having 68% of cases followed by St. Mary with the next highest in 13%. The remaining parishes combined comprised 20% of the cases (Table 1). The dominant stages at diagnosis, stages 2 and 3, together comprised 50% of the cases. Stage 3 had the greater share in 30% among all cervical cancer cases. Grade 2 (moderately differentiated) disease (68%) was the most dominant histologic grade (Table 1). Invasive squamous cell carcinoma comprised the dominant morphological description (90%) (Table 1). At the time of diagnosis/presentation, 63% of cases had employment in the private sector (Table 1).

Colorectal cancer
Among the 79 cases with histologically confirmed colorectal cancer diagnosed during the study period, females (52%) accounted for more of the cases diagnosed (Table 1). The mean (± SD) age at presentation/diagnosis was 65.2 (± 12.1) (95% CI: 62.5–67.9 years, range 32 to 87 years). Across age categories, 51% of cases were between ages 55–74 (Table 1). Across parishes, 56% of the cases were from St. John, and 23% were from St. George, with the remaining 21% of cases spreading across the other 5 parishes except St. Phillip with a zero (0) case count (Table 1). The year 2020 had the most cases presenting for care (34%), with the least number seen in 2019 (9%). The predominant histologic grade was grade 2 (moderately differentiated) disease (73%), while the foremost clinical stage at diagnosis was stage 3 (poorly differentiated) disease (37%). Morphologically, invasive adenocarcinoma was observed in 98% of cases (Table 1). By tumour site, approximately 35% of cases had observed

Table 1 Baseline characteristics of the cases of female breast, cervical, colorectal and prostate cancers in Antigua and Barbuda (2017–2021)

Characteristics	All Four Cancers Combined *N*=391 N (%)	Female Breast Cancer (*N*=163) N (%)	Cervical Cancer (*N*=40) N (%)	Colorectal Cancer (*N*=79) N (%)	Prostate Cancer (*N*=109) N (%)
Age at Presentation/Diagnosis					
Mean age (±SD)	61.5 (±12.9)	58.7 (±13.5)	51.8 (±15.0)	65.2 (±12.1)	66.5 (±7.8)
Mean age 95% CI	60.2 (62.8)	56.6 (60.8)	47.0 (56.6)	62.5–67.9	65.0–67.9
Median age (IQR)	62.0 (17.0)	59.0 (19.0)	51.5 (16.0)	67.0 (20.0)	67.0 (11.0)
Age categories					
20–34	14 (3.6)	8 (4.9)	5 (12.5)	1 (1.3)	0
35–54	93 (23.8)	51 (31.3)	20 (50.0)	19 (24.1)	3 (2.8)
55–74	227 (58.1)	86 (52.8)	12 (30.0)	40 (50.6)	89 (81.7)
≥75	57 (14.6)	18 (11.0)	3 (7.5)	19 (24.1)	17 (15.6)
Sex					
Female	244 (62.4)	163 (100.0)	40 (100.0)	41 (51.9)	0
Male	147 (37.6)	0	0	38 (48.1)	109 (100.0)
Parish (area of residence)					
Barbuda	4 (1.0)	0	1 (2.5)	3 (3.8)	0
St. George	61 (15.6)	30 (18.4)	1 (2.50)	18 (22.7)	11 (10.1)
St. John	217 (55.5)	79 (48.5)	27 (67.5)	44 (55.7)	68 (62.4)
St. Mary	37 (9.5)	17 (10.4)	5 (12.5)	4 (5.1)	11 (10.1)
St. Paul	30 (7.7)	14 (8.6)	2 (5.0)	7 (8.9)	7 (6.4)
St. Peter	27 (6.9)	15 (9.2)	3 (7.5)	3 (3.8)	6 (5.5)
St. Phillip	15 (3.8)	8 (4.9)	1 (2.5)	0	6 (5.5)
Year of Diagnosis/Presentation					
2017	61 (15.6)	26 (16.0)	9 (22.5)	15 (19.0)	11 (10.1)
2018	66 (16.9)	36 (22.1)	6 (15.0)	13 (16.5)	11 (10.1)
2019	74 (18.9)	34 (20.9)	6 (15.0)	7 (8.9)	27 (24.8)
2020	114 (29.2)	35 (21.5)	11 (27.5)	27 (34.2)	40 (36.7)
2021	76 (19.4)	32 (19.6)	8 (20.0)	17 (21.5)	20 (18.4)
Vital Status					
Alive	320 (81.8)	141 (86.5)	26 (65.0)	57 (72.2)	96 (88.1)
Died	71 (18.2)	22 (13.5)	14 (35.0)	22 (27.9)	13 (11.9)
Clinical Stage at Diagnosis					**
Stage 1	n/a	22 (13.5)	6 (15.0)	13 (16.5)	6 (5.5)
Stage 2	n/a	59 (36.2)	8 (20.0)	16 (20.3)	35 (32.1)
Stage 3	n/a	38 (23.3)	12 (30.0)	29 (36.7)	24 (22.0)
Stage 4	n/a	32 (19.6)	6 (15.0)	11 (13.9)	11 (10.1)
Not Stated	n/a	12 (7.4)	8 (20.0)	10 (12.7)	33 (30.3)
Histological Grade					
Grade1	n/a	33 (20.3)	0	3 (3.8)	27 (24.8)
Grade2	n/a	80 (49.1)	27 (67.5)	58 (73.4)	34 (31.2)
Grade3	n/a	15 (9.2)	6 (15.0)	6 (7.6)	28 (25.7)
Not Stated	n/a	35 (21.5)	7 (17.5)	12 (15.2)	20 (18.4)
Morphological Description					
In situ Carcinoma	6 (1.5)	6 (3.7)	n/a	n/a	n/a
Invasive Carcinoma	157 (40.2)	157 (96.3)	n/a	n/a	n/a
Invasive Adenocarcinoma	81 (20.7)	n/a	4 (10.0)	77 (97.5)	n/a
Invasive Squamous Cell Carcinoma	36 (9.2)	n/a	36 (90.0)	n/a	n/a
Acinar Adenocarcinoma	108 (27.6)	n/a	n/a	n/a	108 (99.1)
Prostatic Ductal Adenocarcinoma	1 (0.3)	n/a	n/a	n/a	1 (0.9)
Not Stated	2 (0.5)	n/a	n/a	2 (2.5)	n/a
Evidence of Noncommunicable Disease Other than Cancer					
No	222 (56.8)	82 (50.3)	29 (72.5)	44 (55.7)	67 (61.5)

Table 1 (continued)

Characteristics	All Four Cancers Combined *N* = 391 N (%)	Female Breast Cancer (*N* = 163) N (%)	Cervical Cancer (*N* = 40) N (%)	Colorectal Cancer (*N* = 79) N (%)	Prostate Cancer (*N* = 109) N (%)
Yes	169 (43.2)	81 (49.7)	11 (27.5)	35 (44.3)	42 (38.5)
Employment Sector at Time of Presentation					
Private	183 (46.8)	65 (39.9)	25 (62.5)	35 (44.3)	58 (53.2)
Public	86 (22.0)	47 (28.8)	6 (15.0)	11 (13.9)	22 (20.2)
Retired	122 (31.2)	51 (31.3)	9 (22.5)	33 (41.8)	29 (26.6)
Employment Status at Time of Presentation					
Not employed	122 (31.2)	51 (31.3)	9 (22.5)	33 (41.8)	29 (26.6)
Employed	269 (68.8)	112 (68.7)	31 (77.5)	46 (58.2)	80 (73.4)
Estimated Monthly Income Level at Presentation (XCD)					
≤ 1500	174 (44.5)	36 (22.1)	17 (42.5)	49 (62.0)	72 (66.1)
> 1500	217 (55.5)	127 (77.9)	23 (57.5)	30 (38.0)	37 (33.9)

n/a - not assessed/not applicable/not available

**- stage assumed using Gleason score & grade as proxy

ascending colon disease, 30% sigmoid colon disease, and 11% with disease occurring in the rectum. Across the employment sector, 44% and 42% of cases were employed in the private and public sector, respectively, at the time of presentation/diagnosis.

Prostate cancer

Approximately 109 cases of prostate cancer were diagnosed during the study period. The mean age at presentation was 66.5 (± 7.8) years (95% CI: 65.0-67.9 years, range 46 to 90 years). Distributed across parishes, St. John accounted for 62%, followed by St. George and St. Mary with 10% of cases each. All other parishes, apart from Barbuda with zero (0) cases, accounted for the remaining cases (17%) (Table 1). For the year of presentation, the year 2020 had 37% of all cases, followed by 25% in 2019. Approximately 31% of cases had grade 2 disease, and about 26% had grade 3 disease. The predominant morphologic feature was acinar adenocarcinoma (99%), with a single case of prostatic ductal adenocarcinoma (0.9%) (Table 1).

Incidence rates and patterns

All four cancers

Crude cancer incidence for the four combined cancers was 81.7 (95% CI: 73.8–90.2) per 100,000 population, with age-standardized rates of 65.2 (95% CI: 58.7–71.6) per 100,000 population (see Additional file 2). Across 5-year age-groups, crude incidence increased from a low of 2.6 (95% CI: 0.1–14.4) in persons aged 20–24 years to a peak of 480.7 (95% CI: 361.1-627.2) in persons aged 70–74 years. There was a notable reduction in age-standardized incidence across all levels of age-groups. The age-standardized incidence rate (ASIR) was at its lowest of 0.2 (95% CI: -0.2-0.6) for persons aged 20–24 years and the highest at 11.6 (95% CI: 8.7–14.5) for persons aged 60–64 years (see Additional file 3). Moreover, high ASIRs (≥ 10) were observed in individuals aged 65–69 years (11.4 (95% CI: 8.5–14.4) (see Additional files 2–3). Among parishes (areas of residence) Barbuda, St. John and St. Paul, had low crude incidences of 43.8 (95% CI: 11.9-112.2), 75.3 (95% CI: 65.7–86.0) and 66.0 (44.5–94.2), respectively. Age-standardized incidence rate among parishes was lowest for Barbuda 41.9 (0.8–82.9), and highest in parishes of St. George 123.7 (95% CI: 92.7-154.8), St. Peter 89.2 (95% CI: 55.6-122.9) and St. Mary 76.5 (51.8-101.1) (see Additional file 4). By the year of presentation, the year 2020 had a noticeably high crude incidence 116.3 (95% CI: 95.8-139.8) and age-standardized incidence 90.6 (95% CI: 73.9-107.4). For the remaining years, the ASIR ranged from between 54.5 (95% CI: 40.8–68.2) in 2017 to 61.8 (95% CI: 47.8–75.9) in 2019 (see Additional files 3; 5). In 2021 it was 60.7 (95% CI: 47.1–74.3).

Female breast cancer

The overall crude and ASIRs of female breast cancer cases were found to be 65.3 (95% CI: 55.7–76.2) and 49.9 (95% CI: 42.2–57.5), respectively. The dominant morphological characteristics were invasive disease (crude and age-standardized incidence at 62.9 (95% CI: 53.5–73.6) and 47.8 (95% CI: 40.3–55.2), and in situ disease being low (crude and ASIR at 2.4 (95% CI: 0.8–5.2) and 2.1 (95% CI: 0.4–3.8). Across parishes (area of residence), St. John had the lowest crude and age-standardized incidences of 52.4 (95% CI: 41.5–65.3) and 47.6 (95% CI: 37.1–58.1), respectively, with the highest crude and ASIRs seen in St. George with values 126.7 (95% CI: 85.5-180.9) and 117.3 (95% CI: 75.3-159.3) (Fig. 1) (see Additional file 4). Examined by year of presentation, 2017 had the lowest crude and age-standardized incidence at 53.7 (95% CI: 35.1–78.7) and 42.4 (95% CI: 26.1–58.7), with the highest

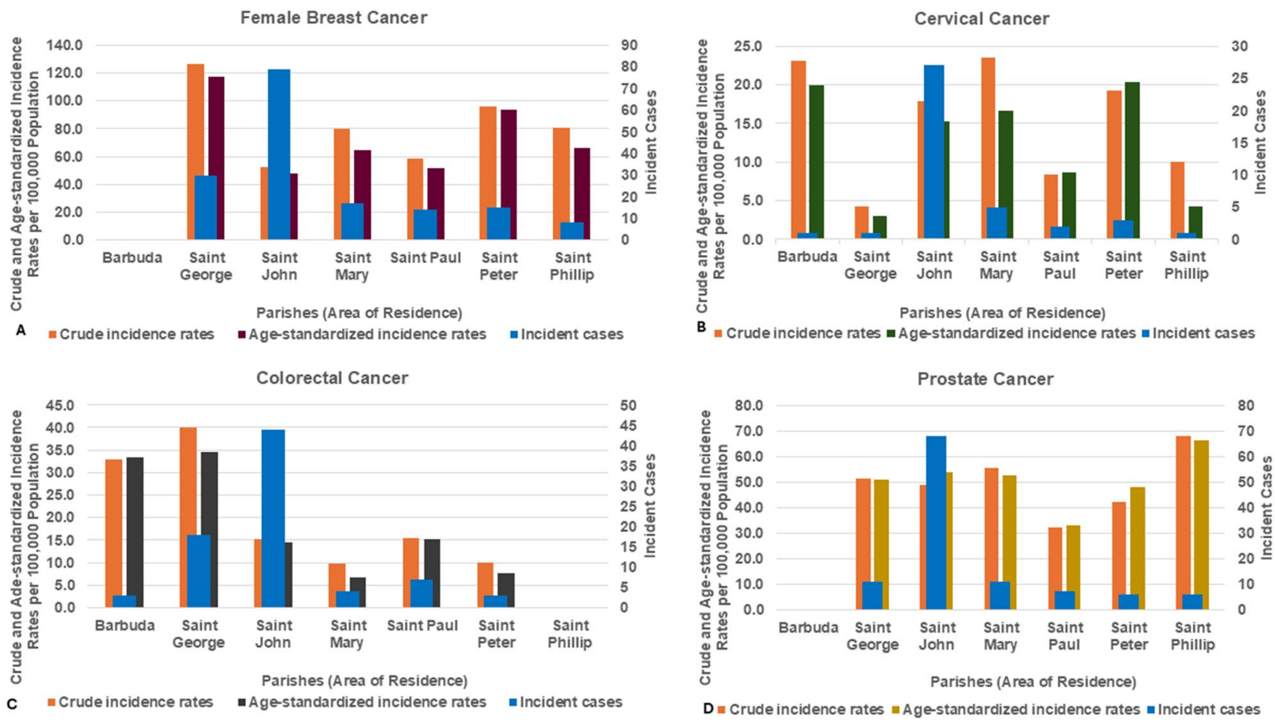

Fig. 1 Incident cases, crude and age-standardized incidences of cancers by parishes in Antigua and Barbuda (2017–2021). **A**- Female breast; **B**- Cervical; **C**-Colorectal; **D**- Prostate

crude incidence and ASIR in 2018 at 73.3 (95% CI: 51.3-101.4) and 57.3 (95% CI: 38.6–76.0) per 100,000 (Fig. 2) (see Additional file 5). The dominant disease subtypes were Luminal A (HR+/HER2-), crude and age-standardized incidences 42.5 (95% CI: 34.8–51.4) and 32.7 (95% CI: 26.5–39.0), respectively, with the next highest being triple negative breast cancer, with crude and age-standardized incidences at 9.6 (95% CI: 6.2–14.3) and 7.4 (95% CI: 4.5–10.4), respectively (see Additional file 6). Except for age-group 75 years and older, where the crude incidence declined to 193.6 (95% CI: 114.7-305.9), there was a general increase in crude incidence as age-groups increased. Variations in ASIRs were observed across each 5-year age-groups, with the lowest being in age-group 20–24 years ($n = 1$, 0.4 (95% CI: -0.4-1.2) and the highest in age-group 55–59 years ($n = 28$, 7.4 (95% CI: 4.7–10.1) (Fig. 3) (see Additional file 7).

Cervical cancer

Overall crude and age-standardized incidence rates of cervical cancer were observed to be 16.0 (95% CI: 11.5–21.8) and 12.0 (95% CI: 8.3–15.7), respectively, with the crude incidence rate varying from a low of 8.9 (0.2–49.5) in women aged 60–64 years to a high of 64.5 (95% CI: 17.6-165.2) for women aged 70–74 years (Fig. 3) (see Additional file 7). Morphologically, squamous cell carcinoma was the predominant histologic subtype among the cases with crude and age-standardized incidences of 12.4 (95% CI: 8.4–17.6) and 9.4 (95% CI: 6.1–12.7), respectively. Cases with a not stated morphology ($n = 6$) had a crude and age-standardized incidence of 2.4 (95% CI: 0-5.2) and 1.7 (95% CI: 0.3–3.1), respectively. Following the proportional assignment of not stated cases to the two subtypes, the crude and age-standardized incidence changed to reflect the crude incidence and standardized incidence of adenocarcinoma at 1.6 (95% CI: 0.4–4.1) and 1.2 (95% CI: 0-2.3), respectively, and that of the dominant squamous cell carcinoma at 14.4 (95% CI: 10.1–20.0) and 10.8 (95% CI: 7.3–14.4), respectively (see Additional file 6). Across parishes, there were noticeable variations in both crude and ASIRs with the parish of St. George having the lowest values of 4.2 (95% CI: 0.1–23.5) and 3.0 (95% CI: -2.8-8.7), respectively, while the parish of St. Mary had values of 23.5 (95% CI: 7.6–54.8) and 16.6 (95% CI: 2.1–31.2), respectively, and St. Peter had a noticeably high age-standardized incidence of 20.4 (95% CI: -2.7-43.5) (Fig. 1) (see Additional file 4). By year of presentation, the year 2020 had the highest crude and ASIRs of cervical cancer at 21.7 (95% CI: 10.8–38.9) and 16.1 (95% CI: 6.6–25.6), respectively, with low crude and age-standardized incidence rates observed at 12.0 (95% CI: 4.4–26.2) and 8.5 (95% CI: 1.7–17.1) in 2019 (Fig. 2) (see Additional file 5).

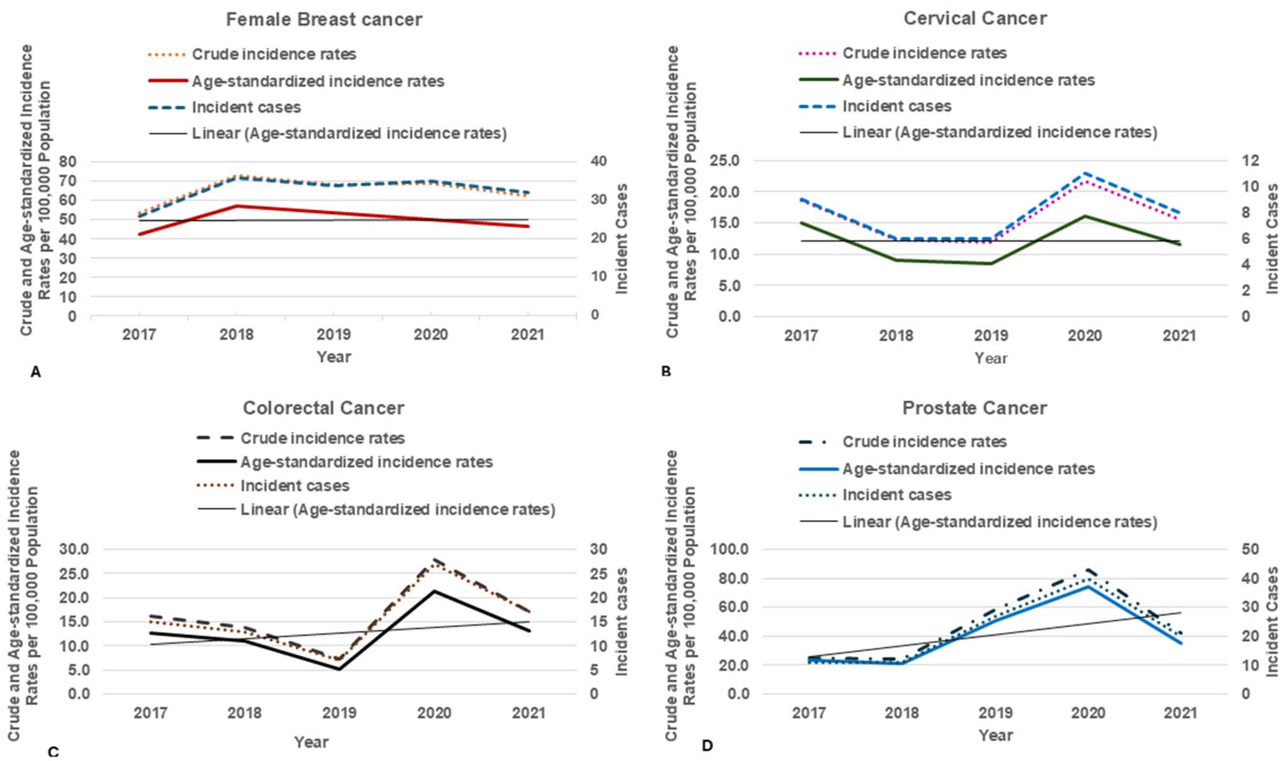

Fig. 2 Age-standardized incidence trends by year of presentation/diagnosis in Antigua and Barbuda (2017–2021). **A**- Female breast; **B**- Cervical; **C**- Colorectal; **D**- Prostate

Colorectal cancer

Overall, the crude and ASIRs were 16.5 (95% CI: 13.1–20.6) and 12.8 (95% CI: 10.0-15.6), respectively, with highly variable crude and ASIRs across 5-year age-groups, inclusive of the stratum with the lone case in persons aged 30–34 years (Fig. 3) (see Additional file 7). Histologically, the most common type of colorectal cancer, adenocarcinoma had a crude incidence of 16.5 (95% CI: 13.1–20.6), with a marginally reduced ASIR of 12.8 (95% CI: 10.0-15.6) (see Additional file 6). Examinations across years of presentation/diagnosis revealed that there were some variations in the crude incidence rates (CIRs) over the years, with the lowest in 2019 at 7.3 (95% CI: 2.9–15.1) and the highest in 2020 at 27.8 (95% CI: 18.3–40.4). These variations were correspondingly observed for the derived ASIRs (Fig. 2) (see Additional file 5).

A high CIR and ASIR were observed for the parish of St. George 39.9 (95% CI: 23.7–63.1) and 34.6 (95% CI: 18.6–50.5), respectively, with the second highest being in Barbuda at 32.9 (95% CI: 6.8–96.1) and 33.3 (95% CI: -4.4-71.1), respectively. In St. John, this was much lower at 15.2 (95% CI: 11.0-20.4) and 14.4 (95% CI: 10.1–18.7). The parish St. Mary had the lowest crude and ASIRs of 9.7 (95% CI: 2.7–24.9) and 6.8 (95% CI: 0.1–13.5), respectively (Fig. 1) (see Additional file 4).

Prostate cancer

Generally, the crude and ASIRs of prostate cancer were observed to be 47.6 (95% CI: 39.1–57.4) and 41.6 (95% CI: 33.8–49.4), respectively, with the age-group 70–74 years having the highest crude incidence of 417.3 (95% CI: 258.3-637.9) and age-group 60–64 years the highest ASIR of 11.5 (95% CI: 7.2–15.7) among 5-year age groups (Fig. 3) (see Additional file 7).

Histologically, the most common type of prostate cancer was acinar adenocarcinoma with crude and ASIRs of 47.1 (95% CI: 38.7–56.9) and 41.2 (95% CI: 33.4–48.9), respectively (see Additional file 6). Across parishes, there fluctuations in the crude and ASIRs were noted. For instance, the crude and ASIRs for St. George were 51.4 (95% CI: 25.7–92.0) and 51.0 (95% CI: 20.9–81.1) respectively, while those for St. John were 49.0 (95% CI: 38.1–62.2) and 53.9 (95% CI: 41.1–66.7), respectively (Fig. 1) (see Additional file 4). By year of presentation, 2020 had highly pronounced crude and ASIRs of 86.0 (95% CI: 61.4-117.1) and 73.9 (95% CI: 51.0-96.8), respectively. Year 2017 had overall lower estimates of 24.4 (95% CI: 12.2–43.6) and 21.5 (95% CI: 8.8–34.2) when compared to the other years in the study period (Fig. 2) (see Additional file 5).

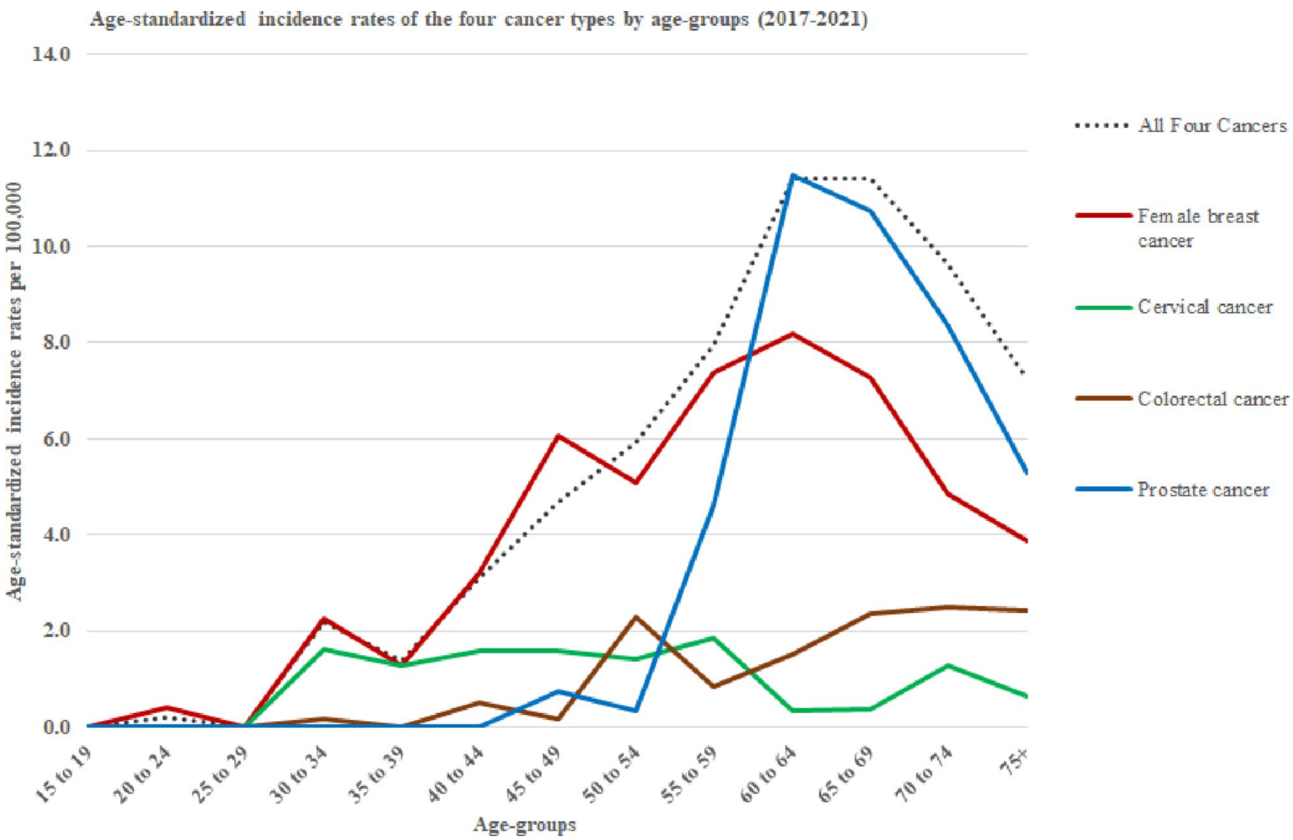

Fig. 3 Age-standardized incidence trends by age-groups in Antigua and Barbuda (2017–2021). **A**- Female breast; **B**- Cervical; **C**-Colorectal; **D**- Prostate

General incidence trends observed

Overall, the results showed that the trends in age-standardized incidence rates differed based on each cancer type and the characteristic being considered. For example, while there was no significant change in the trend of age-standardized incidence rates for female breast and cervical cancers in women during the study period 2017–2021 (female breast- general trend of 49.9 per 100,000 in 2017 to 50.0 per 100,000 in 2021; and cervical - general trend of around 12.5 per 100,000 female population from 2017 to 2021), significant changes have been observed in both colorectal and prostate cancers (Fig. 2). For colorectal cancer, the general trend suggest a linear increase in age-standardized incidence rates from a low of 10.0 per 100,000 population in 2017 to a high of approximately 15.0 per 100,000 population in 2021 (Fig. 2). For prostate cancer, the results indicate a linear shift in age-standardized incidence rates from about 25.0 per 100,000 male population in 2017 to about 58.0 per 100,000 male population in 2021 (Fig. 2).

Joinpoint age-standardized incidence trends

In assessing trends using Joinpoint regression modelling, the results showed that no significant difference in annual percentage change (APC) was observed across the study years for each cancer type ($p > 0.05$) (Table 2) (see Additional file 8). Notwithstanding this observation, acceptable models were those depicting zero (0) Joinpoint, with annual percentage changes (APC) ranging from lows of -0.2 and 0.1 for female breast and cervical cancers, respectively, to highs of 10.3 and 21.7 for colorectal and prostate cancers, respectively (Table 2). In all cases, the 95% CIs contained zero (0), confirming that there was no significant change in the APC across the years. Collectively, the APC was 8.1 (95% CI: -14.5 to 37.6; $p > 0.05$) (Table 2) (see Additional file 9).

Projected incidence rates and trends

An additional table file shows the projected incident cases and ASIRs per 100,000 population for each cancer type over the period from 2022 to 2030 (see Additional files 10–12).

Observed was a low to moderate increase in both incident cases and ASIRs for all four cancer types, except for prostate cancer, where the increase in cancer cases is expected to range from 34 to 60 in the period, with an ASIR ranging from 57.7 (95% CI: 38.3–77.0) to 89.8 (95% CI: 67.1-112.5). Generally, and across each projected year, for female breast, cervical and colorectal cancers, there was a noted overlap among cases and ASIRs, respectively. Cumulatively (all four cancers combined), there was a gradual to sharp rise in both incident cases and CIR per

Table 2 Joinpoint analysis of the trends in cancer-specific incidence rates for the combined cancers, female breast, cervical, colorectal and prostate cancers in Antigua and Barbuda [(2017–2021) & (2022–2030 projected)

Cancer Type	Final Selected Joinpoint Model	Line Segment		APC/95% CI	AAPC/95% CI
Trends in cancer-specific incidence (data from 2017–2021)					
All four cancers (combined)	0	2017	2021	8.1 (-14.5-37.6)	8.1 (-14.5-37.6)
Female Breast	0	2017	2021	-0.2 (-13.0-14.4)	-0.2 (-13.0-14.4)
Cervical	0	2017	2021	0.1 (-27.2-37.6)	0.1 (-27.2-37.6)
Colorectal	0	2017	2021	10.3 (-32.5-80.4)	10.3 (-32.5-80.4)
Prostate	0	2017	2021	21.7 (-32.6-119.8)	21.7 (-32.6-119.8)
Projected trends in cancer-specific incidence (data from 2022–2030)					
All four cancers (combined)	1	2022 2028	2028 2030	3.6 (3.3-4.0) * 2.7 (0.9–4.6) *	3.4 (3.0-3.8) *
Female Breast	1	2022 2028	2028 2030	0 (-1.2-1.3) 1.2 (0-2.4) *	0.6 (-0.0-1.2)
Cervical	0	2022	2030	0.6 (-0.4-1.7)	0.6 (-0.4-1.7)
Colorectal	0	2022	2030	3.9 (3.5–4.4) *	3.9 (3.5–4.4) *
Prostate	1	2022 2028	2028 2030	6.8 (4.3–9.4) * 5.4 (5.0-5.7) *	5.7 (5.2–6.2) *

Annual percentage change (APC)

Average annual percentage change (AAPC)

* Indicates that the APC/AAPC is significantly different from zero at the alpha level (0.05)

Model selection: weighted Bayesian information Criterion (BIC)/parametric method

100,000 population over the projected period, with a gradual but gentle linear increase in ASIRs noted for the same period (see Additional file 11).

When the trend was assessed for the projected incidence rates for each cancer type over the period 2022–2030, the results showed that there were significant differences observed for colorectal and prostate cancers ($p < 0.05$) (Table 2) (see Additional file 13). No significant difference in the APC or average annual percentage change (AAPC) was observed for cervical cancer cases ($p > 0.05$). A significant difference in the APC was observed for female breast cancer cases (final selected model: 1 Joinpoint), however, overall, there was no meaningful difference in the AAPC (see Additional file 13). Cumulatively, the results suggested that there were significant differences in both the APC and the AAPC for the four cancers combined (AAPC 3.4 (95% CI: 3.0-3.8) $P < 0.001$) (Table 2) (see Additional file 14).

Discussion

This study is the first step in providing reasonable evidence of the current incidence, trends and patterns of prostate, female breast, colorectal and cervical cancers in Antigua and Barbuda from 2017 to 2021. The study presented sufficient details on the occurrence of these cancers in terms of parish (area of residence), dominant subtypes, age distribution, and year of presentation/diagnosis, across the island. The findings suggest that the leading cancer according to case number, and age-standardized incidence rate (ASIR) per 100,000 population was female breast cancer, followed by prostate, colorectal and cervical cancer in that order. This finding was dissimilar to the observations noted by Simon et al. 2014, where for the period 2001–2005, it was reported that the cancers with the highest incidence rates in Antigua and Barbuda were prostate cancer, female breast cancer, cervical cancer and colorectal cancer [13]. Although the focus of our study was on four prominent cancers, the results agree with the suggestion of dominance of male prostate cancer and female breast cancer as reported by Simon et al. 2014 and Razzaghi et al. 2016 [13, 28]. Here, standardized incidence rates decreased sharply for prostate cancer from 69.0 per 100,000 (2001–2005) to 41.6 per 100,000 (2017–2021) in the male population, while those for female breast cancer showed a marked increase from 37.6 per 100,000 (2001–2005) to 49.9 per 100,000 (2017–2021) in women [13]. Regarding the other two cancers, there was a drastic reduction in the ASIR of cervical cancer from 23.05 per 100,000 (2001–2005) compared to 12.0 per 100,000 (2017–2021) in females, along with a less severe increase in the ASIR of colorectal cancer to 12.8 per 100,000 from a previous 10.8 per 100,000 population (2001–2005) given by Simon et al. 2014 [13].

These observations are consistent with global trends suggesting that both the number of new cancer cases and the incidence of prostate, female breast and colorectal cancers are projected to steadily rise at a faster pace in low-income countries (LICs) than in more high-income countries (HICs) [2]. This rise could be attributable to several prevalent risk factors including many caused by demographic and economic changes linked to globalization, increasing Westernization of lifestyles and longer life expectancy [2, 29]. The increasing ASIRs of these cancers were underscored in the GLOBOCAN 2020 report, which highlighted that among the top five cancers in terms of incidence and new cases, female breast, prostate and colorectal cancers were evident [2]. Conversely, cervical cancer's noticeably lower incidence rate, though relatively high when compared with that of several countries in other regions of the world with more conservative sexual behaviour [2], mirrors the observed decline seen in many countries across the Caribbean and South America since the early 2000's [2]. The GLOBOCAN 2020 report suggested that improvements in the prevention, screening and diagnosis of this carcinoma might be responsible for these observed declines [2]. However, beyond this conjecture, the declines could be due to lower birth rates and parity, improved hygiene conditions, education and socioeconomic status across the island's female population over time [30].

While the observed incidence rates of the four cancers combined are suggestive of a greater burden of these conditions in persons ≥ 55 years old, differences in cancer-specific incidences by age agreed with previous studies. Our study revealed that the greatest burden of cervical cancer occurred in women of middle to late reproductive age and early menopause, with some of the higher incidence rates occurring in the 30–34 years to the 55–59 years age-groups. This finding is underscored by Brown et al.. 2018, who wrote that reducing the incidence of invasive cervical cancer hinges on concentrating screening efforts on women aged 30 to 59 years at least once per lifetime [29]. Our study was able to highlight this cancer's burden in younger women when compared to the other female cancer under study [29]. Comparatively, for female breast cancer, the burden was greatest for women in the late childbearing to late menopausal age-groups (45–49 to 70–74 years). This makes the case for the adoption of early female breast cancer screening practices, inclusive of encouraging breast self-examination and clinical breast exams for females on the island [31, 32].

Colorectal cancer was dominant in the middle-to older-aged populations. This particular finding is consistent with studies suggesting that the likelihood of developing colorectal cancer increases significantly after age 50, making screening an important care event in individuals entering this decade of life [33–35].

Unlike the other cancers, prostate cancer's dominance was seen in men from as early as pre-retirement years of 55–59 years well into that of old age. Although surprising, it was not unexpected, given the possible effect of underlying disparities in persons belonging to different age strata with respect to demographic variations, genetics, the biology of the disease, lifestyle and environmental exposures [36]. Additionally, the results agreed with evidence suggesting that the incidence rates of prostate cancer progressively increase for men > 50 years of age given existing and disproportionate disparities, including accessibility to care, the Westernization of lifestyle, to wit, obesity, physical inactivity and dietary factors [37, 38].

Our study demonstrated that no parish (Barbuda through to Saint Phillip) was exempt from the burdens of two or more of the cancers examined. The observed differences in ASIRs observed across parishes, however, might be symptomatic of general within country variations due to genetic, ethnic density, and other socioeconomic and environmental factors affecting communities on the island [2, 39]. For example, the variations seen in prostate cancer incidence across parishes could support the role of (i) the Western African ancestry phenomenon in modulating prostate cancer risk for men on the island and (ii) the impact of prostate specific antigen (PSA) testing as part of the current diagnostic toolkit [2, 35].

Further, the phenomenon of ethnically dense communities being at increased risk of cancers of an infectious origin could explain some of the variations observed in the incidence rates of cervical cancer across parishes and in the country as a whole [39]. These factors, including those of wealth distribution, diet and lifestyle, are also suggested as possible reasons for the observed incidence rates of colorectal cancer across Antigua and Barbuda parishes [40]. This occurrence could be supported by Franco 2005 and Alexandrova et al. 2014, who both implied that the interplay between diet and lifestyle factors have a role in the occurrence of colorectal cancer in countries [41, 42].

The study highlighted that the year 2020 had a significantly greater overall burden of all four cancers in terms of cases and ASIRs (apart from female breast cancer cases) than all other years in the study period. However, for prostate cancer, this could be explained by the study site, Sir Lester Bird Medical Centre employing the services of a urologist in that year [15]. This could have unintentionally caused an obvious spike in cases being seen at the facility because of the subsidized care offered to persons via the mechanism of financial capitation to this facility by the Medical Benefits Scheme [15]. One cannot also rule out the impact of the coronavirus disease 2019 (COVID-19) pandemic in shaping this scenario. For instance, in the face of financial hardships and diminished health brought about by the pandemic, residents who would otherwise use private health services, might have comprised those utilizing the country's lone tertiary health facility at the time, hence driving up case numbers [43, 44].

While in several countries, these hardships meant delays in screening, diagnosis, and treatment of these cancers along with a corresponding decline in incidence, in Antigua and Barbuda, coronavirus disease 2019 (COVID-19) restrictions notwithstanding, there was a noted rise in cases seen for 2020 [45, 46]. Though chance could explain this observation, it suggests that the Sir Lester Bird Medical Centre (SLBMC) managed to maintain an elevated level of services for chronic diseases amidst the challenges posed by the pandemic. Furthermore, it hints at an increase in the possible effects of physical, psychological, physiological and other types of stress experienced by people during the pandemic period [47–50]. This infers that, outside of ongoing health education campaigns by the Ministry of Health, pandemic-linked diminished resilience could have accelerated the manifestations of certain disease states that may have been a priori underlying issues for the persons diagnosed [47–50].

Overall, and notwithstanding within years variability in incidence rates for all four cancers, our findings indicate an increasing trend in incidence of prostate and colorectal cancers over the period 2017–2021, as well as an almost zero change in incidence rates of female breast and cervical cancers in the same period. While the observed ranks in age-standardized incidence rates trends for these cancers reflects observations in several Caribbean countries [51], they were generally lower than that of countries in the French West Indies, such as Martinique and Guadalope, which have established cancer registries and where the populations demographic composition are similar [51] and they appeared to be slightly higher than those observed in Trinidad and Tobago where the population is much more heterogeneous than Antigua and Barbuda's [52]. The rising incidence of prostate cancer may be due to a greater use of PSA testing and digital rectal examination (DRE) in widespread screening use and the presence of multiple urologists locally [15, 36], while the increasing trend of colorectal cancer not only reflects current global patterns of increasing incidence, but is also indicative of the salient epidemiological transition observed in other Caribbean countries [51, 53]. The lack of a significant change in incidence trends of female breast and cervical cancer, could be indicative of, among other things, greater public awareness of these diseases locally, improved health-seeking behaviour by women over the years, and comparatively easier access to health care interventions for these conditions on the island [54, 55].

In the absence of mitigating interventions with time, we can expect to see an increase in the number of all cancer-specific cases and incidence rates in the period from 2022 to 2030. Marginal increases in cases are predicted for female breast, cervical and colorectal cancers, whereas sharp increases in cases of prostate cancer are expected.

Generally, the findings of this study could broadly be attributed to improved reporting of cancer diagnosis at the sole tertiary hospital, the presence of the Cancer Centre Eastern Caribbean (TCCEC) which opened in 2009, the institution of weekly tumour board meetings at the Sir Lester Bird Medical Centre (SLBMC), greater sensitization of the population to cancers, the hiring of key specialist physicians, the work of nongovernmental organizations such as Breast Friends (a group started in 1998 that offers support to women affected by breast cancer), improvements in diagnostic and treatment capacity in medical oncological care, and improvements in histopathological and laboratory capacity to mention a few [15]. These developments may have contributed to the cancer burden by causing an increase in the number of cases observed locally.

Strengths and limitations of the study

A strength of our study is the use of cancer data taken from records held at the Sir Lester Bird Medical Centre (SLBMC), Medical Benefits Scheme (MBS), the Cancer Centre Eastern Caribbean (TCCEC) and Health Information Division, Ministry of Health Antigua and Barbuda, all of which contribute to a high proportion of documented evidence of the four cancer cases on the island. This evidence could be useful for all-cause cancer and cancer-specific epidemiological surveillance at the national level [56]. Another strength is that this study provided up-to-date evidence on the incidence of four of the most common cancers in Antigua and Barbuda. The study data generated, and the estimates determined serve both to fill the gap created by the lack of a cancer registry and to demonstrate the importance of establishing one [13, 15].

The influence of bias cannot be excluded in this study. Although bias in the derivation of study estimates was minimized due to the use of direct standardization and Joinpoint regression modeling in our methods, it may have had an impact long before the data were abstracted, or the study design conceived. This could have occurred at the time of selecting individuals for cancer screening, reporting and recording demographic and diagnostic information, and applying the criteria to detect cancerous lesions using various diagnostic tools [57]. This meant that there was a possibility that cancer-specific cases were either under- or over-reported, affecting eventual study results.

Because we had to rely on study data from our main study sites, data from many private sector providers of cancer care services such as laboratories, private clinics and physicians were not included in the study. It is felt that the impact of this limitation, however, would have been minimal based on the richness of the data obtained from the study sites, the shortness of the study period which was 5 years, as well as efforts made by the principal investigator to ensure that information abstracted was as accurate as possible [56, 58, 59]. Another limitation is that the study did not evaluate incidence estimates by ethnic group, given the absence of this information in most records assessed. This would have been attenuated as 85% of the national population is of African ancestry, with other racial groups comprising the remaining 15% [20, 60].

Notwithstanding the stated limitations, we believe that given the country's relatively small population size [60] and the fact that our data sources collectively represent the largest repository of evidence on these cancers in Antigua and Barbuda [61], estimates from our study give a fairly detailed and representative understanding of current knowledge about the incidence, trends and patterns of these common cancers in Antigua and Barbuda.

Implications

This study's findings offer much understanding of the significant role that these four cancers play in contributing to the burden of chronic diseases on the island. Potentially, it has value for instituting important measures at the national level aimed at arresting the burdens observed. This could include acting in earnest to establish a fully functioning cancer registry, supported by legislation that makes the reporting of cancer data mandatory for providers of healthcare. Such a registry would be able to focus on standardized variable definitions and data collation procedures at the time of cancer diagnosis, mortality and survival estimation, and treatment responses among its list of attributes. These attributes could improve data quality assurance, mitigate against selection, reporting and recording biases (with the potential to cause overestimation or underestimation of cases and estimates), and thus strengthen future analyses of cancer research data locally [56, 62]. Furthermore, other important measures that may be employed at the national level could include addressing the risk factors involved in the development of these cancers, understanding the barriers to early detection, and adopting and implementing initiatives to raise public awareness of these cancers. Here, attention could be focused on curbing harmful behaviors such as tobacco smoking, excessive alcohol consumption, physical inactivity, and poor diet and meal planning. These are a set of critical priorities that require enormous resources and political will to address them adequately and sustainably [63].

With the burdens projected to increase in the coming years, this could mean designing targeted health policies that will encourage the implementation of population-wide screening programs, such as the decentralization of mammography screenings as part of early breast tumour detection, and incentivizing the adoption of healthy lifestyles to control the modifiable risk factors where needed [62, 64]. Importantly, is also the benefit of using the study results to introduce health-related programmatic interventions for persons most at risk of these cancers [40].

Besides potentially using preventative and screening interventions to address these cancer burdens, attention must also focus on providing resources for follow-up clinical consultations, improving cancer awareness strategies, providing survivors care, and enhancing the management of medical and cytotoxic waste [40, 62].

Allocating resources to address most of these matters of cancer care also implies that a fully functioning cancer registry, supported by appropriate legislation is in place on the island [16]. This is a key national need that, together with the study results, could stimulate further cancer research, which involves expanding the scope needed to estimate the island's total cancer burden [65].

Conclusions

In conclusion, this study is the first step in providing reasonable evidence on the incidence, trends and patterns of female breast, cervical, colorectal and prostate cancers in Antigua and Barbuda. Female breast and prostate cancers were dominant in terms of case numbers, incidence, and age-standardized incidence rate (ASIR) per 100,000 population in the period 2017–2021. Variations in cancer-specific incidence and age-standardized incidence rates across parishes and years of diagnosis were observed. All four cancer-specific cases and age-standardized incidence rates are expected to increase during the period 2022 to 2030, with marginal increases in incidence and age-standardized incidences predicted for female breast, and colorectal cancers and sharp increases projected for prostate cancer. With a large proportion of the population being of African ancestry, coordinating data capture on these cancers from public and private health facilities through an established population-based cancer registry, and improving health infrastructure and technologies to aid screening, detection, diagnosis and treatment of these conditions as well as conducting risk factor assessment to further understand the patterns and trends across our cancer types and within geographic (parishes) and ethnogeographic spaces of the country are recommended. Besides further research, this study provides a base for (i) encouraging and/or enabling comparisons with data from established cancer registries in the Caribbean region, (ii) improving policies at public health and clinical practice levels on the island, and (iii) instituting effective cancer prevention and control measures, including developing a national cancer plan, enhancing the current cancer surveillance program, agreeing on appropriate health financing models, and adoption of healthy lifestyles initiatives for the country.

Abbreviations

WHO	World Health Organization
IARC	International Agency for Research on Cancer
SLBMC	Sir Lester Bird Medical Centre
TCCEC	The Cancer Centre of the Eastern Caribbean
MBS	Medical Benefits Scheme
ICD-10	International Classification of Diseases Tenth Edition
AJCC 8Ed	American Joint Committee on Cancer Classification Staging Manual Eight Edition
COVID-19	Coronavirus Disease 2019
NCD	Noncommunicable Disease
ASIR(s)	Age-standardized incidence rate(s)
CIR	Crude incidence rate

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12885-025-13459-8.

Supplementary Material 1: Additional file 1: Distribution of incident cases of female breast, cervical, colorectal and prostate cancers across parishes (2017–2021)

Supplementary Material 2: Additional file 2: Age-standardized incidence rate for cases of the four cancers combined expressed by 5-year age-groups

Supplementary Material 3: Additional file 3: Age-standardized incidence rates for all four cancers combined in Antigua and Barbuda (2017–2021). A- Incident Cases and Crude Incidence by Age-groups; B-Age standardized incidence by Age-groups; C- by Parishes (Area of Residence); C- by Year of Presentation/Diagnosis

Supplementary Material 4: Additional file 4: Five-year crude and age-standardized incidence of all four cancers by parish (Antigua & Barbuda 2017–2021)

Supplementary Material 5: Additional file 5: Crude and age-standardized incidence rates of all four cancers by years of presentation/diagnosis (Antigua & Barbuda 2017–2021)

Supplementary Material 6: Additional file 6: Five-year crude and age-standardized incidence rates of each cancer by subtype (2017–2021)

Supplementary Material 7: Additional file 7: Age-standardized incidence rates of female breast, cervical, colorectal and prostate cancers by age-group (2017–2021)

Supplementary Material 8: Additional file 8: Joinpoint incidence trends by cancer types in Antigua and Barbuda (2017–2021). A-Female breast; B-Cervical; C-Colorectal; D-Prostate

Supplementary Material 9: Additional file 9: Joinpoint incidence trends of the four cancers combined (Antigua and Barbuda 2017–2021)

Supplementary Material 10: Additional file 10: Projected incidence cases rates of female breast, cervical, colorectal and prostate cancers (2022–2030)

Supplementary Material 11: Additional file 11: Projected incidence trends of the four cancers combined (Antigua and Barbuda 2022–2030)

Supplementary Material 12: Additional file 12: Projected incidence trends by cancer type in Antigua and Barbuda (2022–2030). A-Female breast; B-Cervical; C- Colorectal; D- Prostate

Supplementary Material 13: Additional file 13: Joinpoint projected incidence trends by cancer type in Antigua and Barbuda (2022–2030). A-Female breast; B- Cervical; C- Colorectal; D- Prostate

Supplementary Material 14: Additional file 14: Joinpoint projected incidence trends of the four cancers combined (Antigua and Barbuda 2022–2030)

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Author contributions
A.A.N.B, T.G.G, and J.N conceptualized the study, and designed the study. A.A.N.B obtained gatekeeper/study sites authorization. S.O.G and J.C.P sifted through records and guided the identification of study cases. A.A.N.B collected and analyzed the data. T.R validated the results. A.A.N.B, T.R, S.O.G, J.C.P and T.G.G interpreted the data. A.A.N.B prepared figures, tables and additional files. T.G.G and J.N reviewed the figures and tables. A.A.N.B wrote the initial draft of the manuscript. A.A.N.B, T.R, T.G.G, and J.N revised the manuscript. S.O.G and J.C.P reviewed the manuscript. J.N and T.G.G supervised the study. All the authors read and approved the final manuscript.

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Data availability
Data sets generated during this study and that support the study findings are available from the corresponding author on reasonable request and with permission from the study sites. The data generated for this study are from the Sir Lester Bird Medical Centre, Medical Benefits Scheme, The Cancer Centre Eastern Caribbean and the Health Information Division, Ministry of Health, Antigua and Barbuda and so are not publicly available due to institutional access rights.

Declarations

Ethics approval and consent to participate
The Antigua and Barbuda Institutional Review Board, Ministry of Health (AL-04/052022-ANUIRB), the Institutional Review Board of the Sir Lester Bird Medical Centre and the University of KwaZulu-Natal Biomedical Research Ethics Committee (BREC/00004531/2022) approved this retrospective study and waived the requirement for written informed consent. This study was conducted in accordance with the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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