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Survival from five common cancers in Georgia, 2015–2019 (CONCORD)

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ABSTRACT

Background: Population-based cancer survival is a key metric of the effectiveness of health systems in managing cancer. Data from population-based cancer registries are essential for producing reliable and robust cancer survival estimates. Georgia established a national population-based cancer registry on 1 January 2015. This is the first analysis of population-based cancer survival from Georgia.

Methods: Data were available from the national cancer registry for 16,359 adults who were diagnosed with a cancer of the stomach, colon, rectum, breast (women) or cervix during 2015–2019. We estimated age-specific and age-standardised net survival at one, two and three years after diagnosis for each cancer, by sex.

Results: The data were of extremely high quality, with less than 2% of data excluded from each dataset. For the patients included in analyses, at least 80% of the tumours were microscopically verified.

Age-standardised three-year survival from stomach cancer was 30.6%, similar in men and women. For colon cancer, three-year survival was 60.1%, with survival 4% higher for men than for women. Three-year survival from rectal cancer was similar for men and women, at 54.7%. For women diagnosed with breast cancer, three-year survival was 84.4%, but three-year survival from cervical cancer was only 67.2%.

Conclusion: Establishment of a national cancer registry with obligatory cancer registration has enabled the first examination of population-based cancer survival in Georgia. Maintenance of the registry will facilitate continued surveillance of both cancer incidence and survival in the country.

1. Introduction

Population-based cancer survival is a key metric of the effectiveness of health systems in managing cancer [1]. The monitoring of trends and inequalities in cancer survival can reveal health system performance, guide investment priorities for cancer care and control, and help advance cost-effective interventions to improve early diagnosis and treatment [2].

Population-based cancer registries are essential public health instruments. From a basic set of data collected on every malignant neoplasm diagnosed in residents of a given country or territory, they can provide reliable measures of cancer incidence and survival. These data can then be used to guide a national strategy for cancer care and control.

Georgia has a rapidly ageing population, and one-fifth of the population is expected to be aged 65 years or older by 2030 [3]. Life expectancy at birth in 2019 was 69.8 years for males and 78.4 years for females, lower than the European average (74.5 and 80.9, respectively), but slightly higher than the average for countries in the Commonwealth of Independent States (67.3 and 76.6, respectively) [4,5]. The gap in life expectancy between men and women is largely driven by the higher

Abbreviations: GDP, Gross Domestic Product; IARC, International Agency for Research on Cancer; ICSS, International Cancer Survival Standard; ICD-O-3, International Classification of Diseases for Oncology 3rd edition; NCDC, National Centre for Disease Control; UHC, Universal Health Coverage.

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probability of death among men in the age range 15–60 years [6].

In Georgia, non-communicable diseases are responsible for most morbidity and mortality in adults. In 2019, 10,339 persons were diagnosed with cancer, and 7873 deaths (12% of the total) were attributed to cancer [4,7]. The five most common cancers were those of lung, prostate, bladder, colorectum and larynx in men, and breast, thyroid, colorectum, cervix and uterus in women [8].

1.1. Health system and policies in Georgia

Over the past two decades, the health system in Georgia has undergone several changes designed to ensure access to high-quality services for the entire population, to reduce the financial burden of health care for individuals, and to improve primary health care [10]. The current health system is financed by a mix of public and private funding, though most health providers are privately managed [3,11]. The Universal Health Coverage (UHC) programme, introduced in 2013, provides publicly funded financial coverage for most of the population, with the level of coverage dependent upon household income [3,11]. In 2017, households in the highest income bracket (1.2% of the population), who earn more than ₾40,000 (Georgian Lari; US$12,965) annually were excluded from the UHC programme. Persons in that group are expected to have private health insurance [11]. The UHC programme has greatly improved access to health services for many Georgians, particularly those living below the poverty line [3,11]. The costs of cancer treatment are covered under the UHC programme [3]. Although there is an out-of-pocket co-payment, dependent upon the patient's income, those living below the poverty line pay nothing [3,11].

Current expenditure on health was 7.1% of gross domestic product (GDP) in 2018, below the average for Europe (7.5%), but about average for countries in the Commonwealth of Independent States (7.1%) [3,12].

Due to the rapidly ageing population, the growing impact of the cancer burden on the health system is a concern for policy-makers. The National Cancer Control Strategy for Georgia, currently in draft form, will aim to increase survival through the promotion of standardised care of patients, which includes increasing access to high-quality treatment, strengthening the capacity of modern technology for diagnosis and treatment, and improving access to palliative care.

1.2. Georgian Population-Based Cancer Registry

The national Population-Based Cancer Registry began registering incident cases for patients diagnosed with cancer from 1 January 2015. Before then, the National Centre for Disease Control (NCDC) received data from various medical facilities that offered services to cancer patients. Establishment of the registry has greatly improved the completeness of data on cancer patients [8,11].

The registry's mission is to produce comprehensive and accurate data on cancer morbidity and mortality, and to evaluate the effectiveness of cancer care through examination of cancer survival. The registry is part of the NCDC; it does not have a separate budget, but it has two full-time and three part-time employees. Statisticians from NCDC can also be deployed, but they are not assigned exclusively to the registry.

Since 2012, all doctors and pathologists who provide cancer services are obliged to notify the registry of every patient diagnosed with cancer, regardless of the date of original diagnosis, under a regulation from the Ministry of Labour, Health and Social Affairs (order #01–27/N: Production and delivery of medical statistical information). The dates of diagnosis, investigation and treatment are also collected for patients diagnosed before 2015, but those patients are not included in analyses of incidence or survival from 2015. The registry also accesses independent sources such as the Hospital Discharge Registry, the Social Assistance Agency database and the national mortality database. Data quality is monitored with the International Agency for Research on Cancer (IARC) Check Tool. Autopsies are rarely done, except by court order in relation to a crime.

Since 2019, the cancer registry has used a unified electronic system to capture data on all cancer patients, including attendance at a screening programme, as well as details of the diagnosis and treatment from multiple sources. This system is connected to the data system for births and deaths, and each registered patient's vital status is updated in real time. The vital status of registered cancer patients is obtained through passive follow-up, by linkage between the registry data and the national mortality database: this is carried out daily.

We have set out to establish real-world surveillance of population-based cancer survival in Georgia for the first time, using observed data from the cancer registry, rather than models based on assumptions and data from other countries. We have used the most recent data to provide estimates of survival up to three years after diagnosis, by age and sex, for five common cancers (stomach, colon, rectum, breast and cervix). These cancers were selected as they are of public health importance in Georgia.

We intend these estimates to inform investment strategy for the health system, to improve cancer outcomes as a contribution to public health, and to help drive the national strategy for cancer control. The survival estimates will also enable international comparison with other countries contributing to the CONCORD programme for the global surveillance of cancer survival [13].

2. Materials and methods

Anonymised data from the national registry were made available for 16,359 adults (aged 15–99 years) who were diagnosed with one of five common cancers during 2015–2019. We included patients diagnosed with a cancer of the stomach (topography codes C16.0-C16.6 and C16.8-C16.9 in the third edition of the International Classification of Diseases for Oncology, ICD-O-3 [14]), colon (C18.0-C18.9; C19.9), rectum, anus and anal canal (C20.9; C21.0-C21.1; C21.8), breast (women only; C50.0-C50.6; C50.8-C50.9) or uterine cervix (C53.0-C53.1; C53.8-C53.9). Follow-up data were available on each patient's vital status (alive, dead, lost to follow-up) at 31 December 2019.

We requested data on all tumours, including benign and *in situ*, to enable assessment of the intensity of diagnostic activity. However, only primary, invasive tumours (ICD-O-3 behaviour code 3) were included in survival analyses. If a patient was diagnosed with two or more primary, invasive tumours of the same site, then only the first record was included. Patients whose cancer registration was from a death certificate or autopsy only were excluded, because their true survival time was unknown. The data set for each cancer was subjected to the centralised data quality control procedures used in CONCORD-3, to ensure that data included in the analyses were of the highest quality possible [13].

We estimated net survival at one, two and three years after diagnosis by age group and sex. Net survival is the probability that a cancer patient survives their cancer up to a given time since diagnosis, after correcting for other causes of death (background mortality). Net survival was estimated using the non-parametric Pohar Perme estimator [15], implemented using *stns* [16] in Stata version 15.

We used the complete approach [17] to estimate net survival up to three years for all patients diagnosed during the five years 2015–2019. To account for differences and changes in background mortality by age and sex over time, we used life tables of all-cause mortality by single year of age, sex and calendar year. To create the life tables, we used the abridged (by age group) Georgia national life tables for calendar periods 2010–2015 and 2015–2019 published by the United Nations Population Division [18]. We centred these life tables on years 2012 and 2017 and smoothed them using the Elandt-Johnson method [19] to produce single-year-of-age life tables. We produced single-calendar-year life tables by linear interpolation between the life tables centred on years 2012 and 2017 for the intervening years. For 2018 and 2019, rather than extrapolate, we used the life table for 2017.

We estimated survival for five age groups (15–44, 45–54, 55–64, 65–74 and 75–99 years). To facilitate international comparisons, we produced age-standardised estimates for all ages combined with the

Table 1
Number and percentage of patients ineligible or excluded from analysis by type of exclusion criteria and cancer, patients diagnosed from 2015 to 2019.

	Stomach		Colon		Rectum		Breast (women)		Cervix	
	No.	%	No.	%	No.	%	No.	%	No.	%
Total submitted	**2036**	**100.0**	**2501**	**100.0**	**1348**	**100.0**	**9238**	**100.0**	**1824**	**100.0**
In situ neoplasm	4	0.2	2	0.1	6	0.4	142	1.5	122	6.7
Ineligible morphology	23	1.1	8	0.3	2	0.1	1	<0.1	..	..
Age at diagnosis < 15 or 100 + years	3	0.1	1	<0.1	..	..	..	..	1	0.1
Total not eligible	**30**	**1.5**	**11**	**0.4**	**8**	**0.6**	**143**	**1.5**	**123**	**6.7**
Patients who are eligible for survival analysis	**2006**	**100.0**	**2490**	**100.0**	**1340**	**100.0**	**9095**	**100.0**	**1701**	**100.0**
Sex-site error[a]	..	..	..	..	..	..	134	1.5	2	0.1
Site-morphology mismatch[a]	5	0.2	7	0.3	5	0.4	15	0.2	28	1.6
Age-site mismatch[a]	..	..	1	<0.1	..	..	1	<0.1	..	..
Age-site-morphology mismatch[a]	..	..	1	<0.1	..	..	..	..	..	..
Invalid date(s) or date sequence	25	1.2	30	1.2	5	0.4	11	0.1	3	0.2
Total exclusions	**30**	**1.5**	**39**	**1.6**	**10**	**0.7**	**161**	**1.8**	**33**	**1.9**
Patients included in analyses	**1976**	**98.5**	**2451**	**98.4**	**1330**	**99.3**	**8934**	**98.2**	**1668**	**98.1**

[a] Sex-site error, site-morphology mismatch, age-site mismatch and age-site-morphology mismatch are all potential errors in the patient record due to unlikely combinations of sex, site, age and/or morphology.

Table 2
Distribution of various characteristics for each cancer, patients diagnosed 2015–2019 in Georgia.

	Stomach		Colon		Rectum		Breast (women)		Cervix	
	No.	%	No.	%	No.	%	No.	%	No.	%
Patients included in analyses	1976	100.0	2451	100.0	1330	100.0	8934	100.0	1668	100.0
Microscopically verified	1595	80.7	2068	84.4	1132	85.1	7291	81.6	1390	83.3
Non-specific morphology[a]	441	22.3	462	18.8	230	17.3	1927	21.6	362	21.7
Death within 30 days	187	9.5	139	5.7	41	3.1	93	1.0	25	1.5
Males	1220	61.7	1258	51.3	735	55.3	..	..	..	..

[a] ICD-O-3 morphology codes 8000–8005

International Cancer Survival Standard (ICSS) weights for those age groups [20]. We did not estimate survival if fewer than ten patients were available for analysis. If 10–49 patients were available for analysis, we present unstandardised estimates for all ages combined. If 50 or more patients were available, we attempted survival estimation for each age group. If a single age-specific estimate could not be produced, then data for adjacent age groups were pooled and the re-estimated survival was used for both of the original age groups. If two or more age-specific estimates could not be produced, we report only the unstandardised survival estimate for all ages combined.

The CONCORD-3 protocol, the ethical approvals and the data quality control procedures have been described [13].

3. Results

3.1. Stomach cancer

We examined data for 2036 adults (15–99 years) diagnosed during 2015–2019 (Table 1). We excluded data for 30 patients (1.5%) diagnosed with an *in situ* tumour or a tumour with an ineligible morphology, or who were outside the age range 15–99 years. Of the 2006 eligible patients, 1976 (98.5%) were included in survival analyses. Of those, 1595 (80.7%) had tumours that were microscopically verified, although 441 (22.3%) of these with non-specific morphology (Table 2).

Results were available for 1976 adults (1220 men; 756 women) (Table 3). Age-standardised net survival at one year was 47.7% (95% CI: 45.4–50.1%) for both sexes combined, while two-year survival was 34.4% (31.9–36.8) and three-year survival 30.6% (28.1–33.2%) (Table 4). One-year survival was slightly higher in men than in women (49.2%, 46.0–52.3% *vs.* 45.9%, 42.2–49.6%), but survival was very similar at two years (men: 34.4%, 31.2–37.6%; women: 34.8%, 31.1–38.5%) and three years (men: 30.4%, 27.0–33.8%; women 31.4%, 27.5–35.3%).

Net survival was generally lower in successive age groups for both men and women (Table 5, Fig. 1). The largest difference in one-year survival between men and women was for those aged 75–99 years, with survival 10% higher in men. For two- and three-year survival, the largest gap was between those aged 65–74 years, with survival 8–10% higher in women. One- and three-year survival declined steadily with increasing age, though the drop in survival was much greater for the oldest age group. For two-year survival, the largest decline in survival between successive age groups was between those aged 15–44 and 45–54 years.

3.2. Colon cancer

We examined data for 2501 adults diagnosed during 2015–2019. We excluded 11 patients (0.4%) diagnosed with an *in situ* tumour or a tumour with an ineligible morphology, or who were outside the age range 15–99 years (11 patients) at diagnosis (Table 1). After all other exclusions, 2451 (98.4%) of eligible patients were included in survival analyses. The tumours for 2068 (84.4%) of these patients were microscopically verified, although 462 (18.8%) were of non-specific morphology (Table 2).

Results were available for 2451 adults (1258 men; 1193 women) (Table 3). Age-standardised one-year net survival was 74.8% (95% CI: 72.8–76.8%) for both sexes combined (Table 4). Two-year survival was substantially lower, at 64.4% (62.0–66.8%) and three-year survival 60.1% (57.3–62.8). Survival was 1–2% higher in men than in women at one and two years (one-year survival: 75.6%, 72.7–78.4% *vs.* 74.1%, 71.4–76.9% and two-year survival: 65.4%, 61.9–68.9% *vs.* 63.7%, 60.5–67.0%), widening to a 4% difference at three years (62.2%, 58.2–66.3% *vs.* 58.1%, 54.4–61.8%).

Survival was generally lower in successive age groups for men and women (Table 5, Fig. 1), however, three-year survival for men did not differ much with age. The largest difference in survival between men and women was for those aged 75–99 years, with survival in men 5% higher at one year and 12% higher at three years. Survival declined steadily with increasing age, though the drop in survival was much greater between the two oldest age groups.

Table 3
Number of adults (15–99 years) diagnosed with stomach, colon, rectal, breast (women) or cervical cancer during 2015–2019, by sex.

Age group (years)	Stomach						Colon						Rectum						Breast		Cervix	
	All persons		Men		Women		All persons		Men		Women		All persons		Men		Women		Women		Women	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No	%	No.	%
15–44	**108**	5.5	**54**	4.4	**54**	7.1	**115**	4.7	**67**	5.3	**48**	4.0	**75**	5.6	**43**	5.9	**32**	5.4	**1396**	15.6	**369**	22.1
45–54	**217**	11.0	**132**	10.8	**85**	11.2	**262**	10.7	**136**	10.8	**126**	10.6	**161**	12.1	**78**	10.6	**83**	13.9	**2066**	23.1	**499**	29.9
55–64	**586**	29.7	**389**	31.9	**197**	26.1	**675**	27.5	**369**	29.3	**306**	25.6	**403**	30.3	**238**	32.4	**165**	27.7	**2622**	29.3	**447**	26.8
65–74	**589**	29.8	**385**	31.6	**204**	27.0	**778**	31.7	**401**	31.9	**377**	31.6	**387**	29.1	**220**	29.9	**167**	28.1	**1845**	20.7	**258**	15.5
75–99	**476**	24.1	**260**	21.3	**216**	28.6	**621**	25.3	**285**	22.7	**336**	28.2	**304**	22.9	**156**	21.2	**148**	24.9	**1005**	11.2	**95**	5.7
All ages	**1976**	100.0	**1220**	100.0	**756**	100.0	**2451**	100.0	**1258**	100.0	**1193**	100.0	**1330**	100.0	**735**	100.0	**595**	100.0	**8934**	100.0	**1668**	100.0

3.3. Rectal cancer

We examined data for 1348 men and women diagnosed during 2015–2019. Patients diagnosed with an *in situ* tumour or with a tumour of ineligible morphology were not included in analyses (8 patients, 0.6%) (Table 1). Of the 1340 eligible patients, 1330 (99.3%; 735 men, 595 women) were included; microscopic verification was available for 1132 (85.1%) of these (Table 2).

Results were available for 1330 adults (735 men; 595 women) (Table 3). Age-standardised one-year net survival was 77.2% (95% CI: 74.6–79.9%) (Table 4). Survival falls sharply at two years (63.5%, 60.2–66.8%), and again at three years (54.7%, 50.9–58.5%). No systematic differences in age-standardised survival were seen between men and women.

One-year survival decreased with increasing age in men (Table 5, Fig. 1). One-year survival was slightly higher in women aged 45–54 years (87.9%, 95% CI: 80.3–95.5%) than those aged 15–44 years (85.7%, 72.8–98.5%). A similar pattern was seen in two-year survival, with survival highest for those aged 45–54 years (76.0%, 68.5–83.5% for both sexes combined). Though three-year survival was lowest for adults aged 75–99 years, there was no trend with age at diagnosis. Among men, three-year survival was highest aged 65–74 years (60.6%, 51.3–69.9%), and among women, for those aged 55–64 years (70.4%, 61.6–79.2%).

Net survival was generally lower in successive age groups for both men and women (Table 5, Fig. 1). The largest difference in one-year survival between men and women was for those aged 45–54 years, with survival 7% higher in women. For two-year survival, the largest gap was between those aged 75–99 years, with survival 9% higher in men. For three-year survival, the gap was largest between men and women aged 55–64 years, with survival 14% higher in women. Survival declined steadily with increasing age, though the decrease in survival was much greater for the oldest age group.

3.4. Breast cancer

We examined data for 9238 women diagnosed during 2015–2019 (Table 1). We excluded women with *in situ* tumours and those with ineligible morphology (143 women, 1.5%). Of the 9095 women eligible, 8934 (98.2%) were included in the analyses. Most of these tumours were microscopically verified (7291; 81.6%, Table 2).

Results were available for 8934 women (Table 3). Age-standardised one-year net survival was high at 93.0% (95% CI: 92.1–93.9%) (Table 4). The decline in survival with time since diagnosis were modest: two-year survival was 88.0% (86.8–89.3%) and three-year survival 84.4% (82.7–86.0%).

Survival generally decreased with increasing age (Table 5, Fig. 1), but three-year survival was virtually the same for women aged 55–64 years and those aged 65–74 years (84.3%, 95% CI: 82.5–86.1% and 84.6%, 82.1–87.1%). The largest difference in survival between the youngest (15–44 years) and oldest (75–99 years) age groups was seen in two-year survival (93.8%, 92.4–95.3% *vs.* 84.2%, 80.5–87.9%).

3.5. Cervical cancer

We examined data for 1824 women diagnosed during 2015–2019 (Table 1). We excluded 123 women (6.7%) diagnosed with an *in situ* tumour, or who were outside the age rage 15–99 years. Of the 1701 women eligible, 98.1% (1668) were included in the analyses. Most tumours were microscopically verified (1390, 83.3%) (Table 2).

Results were available for 1668 women (Table 3). Age-standardised one-year net survival was relatively high (85.9%, 95% CI: 83.7–88.1%) (Table 4). Age-standardised two- and three-year survival was much lower (72.8%, 70.0–75.6% and 67.2%, 64.0–70.3%, respectively).

Net survival was progressively lower with increasing age at diagnosis (Table 5, Fig. 1), except for two-year survival, which was very similar for

Table 4
Age-standardised net survival (NS, %) at one, two and three years after diagnosis, by sex: adults (15-99 years) diagnosed with one of five common cancers in Georgia during 2015-2019.

	Stomach						Colon					
	All persons		Men		Women		All persons		Men		Women	
	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	**NS (%)**	95% CI
One year	**47.7**	45.4–50.1	**49.2**	46.0–52.3	**45.9**	42.2–49.6	**74.8**	72.8–76.8	**75.6**	72.7–78.4	**74.1**	71.4–76.9
Two years	**34.4**	31.9–36.8	**34.4**	31.2–37.6	**34.8**	31.1–38.5	**64.4**	62.0–66.8	**65.4**	61.9–68.9	**63.7**	60.5–67.0
Three years	**30.6**	28.1–33.2	**30.4**	27.0– 33.8	**31.4**	27.5–35.3	**60.1**	57.3–62.8	**62.2**	58.2–66.3	**58.1**	54.4–61.8

	Rectum						Breast		Cervix	
	All persons		Men		Women		Women		Women	
	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI
One year	**77.2**	74.6–79.9	**76.6**	72.9–80.3	**78.0**	74.2–81.7	**93.0**	92.1–93.9	**85.9**	83.7–88.1
Two years	**63.5**	60.2–66.8	**64.1**	59.5–68.6	**63.1**	58.4–67.8	**88.0**	86.8–89.3	**72.8**	70.0–75.6
Three years	**54.7**	50.9–58.5	**53.4**	48.0–58.8	**56.8**	51.6–62.0	**84.4**	82.7–86.0	**67.2**	64.0–70.3

women aged 55–64 years (68.9%, 95% CI: 63.9–73.9%) and 65–74 years (69.2%, 62.6–75.9%). Three-year survival declined sharply with increasing age, from 83.2% (78.8–87.7%) for women aged 15–44 years to 44.9% (30.9–58.9%) for those aged 75–99 years.

4. Discussion

This is the first study of population-based cancer survival in Georgia, including data on 16,359 adults diagnosed with one of five cancers during 2015–2019. Real-world data from the Georgian Population-Based Cancer Registry were essential.

Age-standardised three-year survival from stomach cancer was around 30% for both men and women. Survival generally decreased steadily with increasing age, however, there was a large difference in survival between adults aged 15–44 and those aged 45–54 years. There is no population-based screening programme for stomach cancer in Georgia [8]. In countries with longstanding endoscopic screening (*e.g.*, Korea), five-year survival from stomach cancer has increased steadily over time [13]. However, the World Health Organisation does not recommend inclusion of stomach cancer among the screening programmes in Georgia. Resources are limited, and ten years after implementation of screening for breast and cervical cancer, coverage has still not reached recommended levels. Instead, the plan is to develop other strategies for early detection of stomach cancer [8].

Age-standardised three-year survival from colon and rectal cancers was moderate, around 55–60% for both men and women. A population-based colorectal screening programme was established in Tbilisi in 2010 and expanded to the rest of the country in 2011. Adults aged 50–70 years are invited to attend their first screening appointment *via* media campaigns or through their primary care doctors, and then invited *via* telephone to attend annual screenings. Age-specific survival for both colon and rectal cancers is similar for adults in the age range 15–74 years, but survival for older adults (75–99 years), is much lower than that for adults aged 65–74 years. Among adults aged 75–99 years, three-year survival from rectal cancer is 4% higher in men than in women, and substantially higher for colon cancer (61.2% *vs.* 48.9%).

Age-standardised one-, two- and three-year survival from breast cancer was high. Population-based biannual breast screening for women aged 40–70 years was established in 2008 for women living in Tbilisi, and expanded to the rest of the country in 2011. Recruitment to the screening programme is similar to that for the colorectal cancer screening programme. Age-specific one-, two- and three-year survival is generally similar with increasing age, probably due to most women being eligible for screening.

Age-standardised three-year survival for cervical cancer is only moderate (67.2%). Population-based screening for cervical cancer was established in 2008 for women aged 25–60 years living in Tbilisi, and expanded to the entire country in 2011. Women are screened every three years. Unlike the pattern for breast cancer, three-year survival for cervical cancer is substantially higher for younger women (15–44 years; 83.2%) than for older women (75–99 years; 44.9%).

In 2017, a vacination programme for human papilloma virus (HPV) was launched for girls aged 9 years in four teritories of the country. Since September 2019, HPV vaccination coverage has been expanded and all girls aged 10–12 years are included. By the end of 2019, 48% of girls had received their first of two doses of the HPV vaccine and 36% had received their second dose [4].

Participation in screening programmes is extremely low. In 2019, only 3% of adults aged 50–70 years were screened for colorectal cancer, 14% of women aged 40–70 years were screened for breast cancer and 11% of women aged 25–60 years were screened for cervical cancer [8]. This is probably due to lack of population awareness of cancer and the importance of screening, as well as the lack of involvement of primary care practitioners in recruitment of patients for screening.

The availability of and access to cancer treatment does not appear to be a major barrier to receiving high quality care for cancer patients in Georgia. Cancer-directed surgery is often available without long waiting times at specialist centres and is covered by the UHC programme. Radiotherapy and systemic treatment are also provided without long delays and are partially covered by the UHC programme, with the amount of the co-payment dependent on the patient's income [11].

Nevertheless, on the basis of estimates from the United States' National Cancer Institute in 2015 [21], 57% of newly diagnosed cancer patients in Georgia would be expected to need radiotherapy and 72% would require systemic therapy, whereas in 2019, only 28% of cancer patients actually received radiotherapy and 58% received systemic therapy [8]. The under-utilisation of these key treatment modalities, despite their availability, may be partly explained by the lack of involvement of primary care physicians in discussions about treatment for their cancer patients. Stigma about radiotherapy still exists in Georgia (personal communication: Prof Gamkrelidze). More active participation of primary health care providers in discussions about treatment for cancer would be likely to help assuage fears and reduce stigma, and would help encourage wider and more timely access to these treatment modalities [22,23].

Efforts are now being made to increase the capacity and resources of Georgia's health system. Georgia's Social-Economic Development Strategy, Georgia 2020, aims to improve access to high-quality health care [3]. Of particular importance are the out-of-pocket costs for pharmaceuticals for patients with cancer, since these medicines comprise a

Table 5
Age-specific net survival (NS, %) at one, two and three years, by sex: adults (15–99 years) diagnosed with one of five common cancers in Georgia during 2015–2019.

Age group (years)	One year						Two years						Three years					
	All persons		Men		Women		All persons		Men		Women		All persons		Men		Women	
	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI
Stomach																		
15–44	**61.4**	52.0–70.9	**59.7**	46.4–73.1	**63.2**	50.1–76.3	**49.0**	39.0–59.0	**48.1**	34.0–62.2	**50.0**	36.1–63.9	**49.1**	39.1–59.1	**48.3**	34.1–62.5	**50.1**	36.1–64.0
45–54	**54.8**	47.9–61.6	**57.4**	48.5–66.2	**50.9**	40.1–61.7	**38.0**	31.1–45.0	**35.2**	26.3–44.1	**41.9**	31.1–52.7	**31.3**	24.2–38.4	**29.0**	20.0–38.0	**34.4**	23.2–45.6
55–64	**53.7**	49.4–57.9	**54.7**	49.4–59.9	**51.7**	44.5–59.0	**39.1**	34.7–43.5	**40.5**	35.0–46.0	**36.6**	29.3–43.9	**34.1**	29.5–38.7	**34.3**	28.6–40.0	**33.9**	26.4–41.5
65–74	**50.5**	46.1–54.9	**49.4**	44.0–54.9	**52.5**	45.2–59.7	**35.7**	31.1–40.2	**32.3**	26.7–37.9	**42.1**	34.4–49.7	**30.4**	25.6–35.1	**27.5**	21.7–33.3	**35.3**	27.3–43.3
75–99	**34.1**	29.3–38.9	**38.6**	31.9–45.3	**28.5**	21.8–35.2	**24.2**	19.4–29.0	**28.1**	21.1–35.1	**19.6**	13.2–25.9	**23.4**	18.2–28.6	**26.4**	18.9–34.0	**19.7**	12.7–26.6
Colon																		
15–44	**85.3**	78.3–92.3	**84.7**	75.3–94.1	**85.9**	75.4–96.4	**73.9**	64.5–83.2	**71.1**	58.2–84.0	**77.4**	64.3–90.6	**65.7**	54.9–76.5	**61.8**	46.8–76.7	**70.2**	55.0–85.4
45–54	**82.7**	77.8–87.5	**83.7**	77.1–90.3	**81.5**	74.4–88.6	**69.4**	63.0–75.7	**68.3**	59.4–77.2	**70.6**	61.7–79.5	**61.9**	54.8–69.0	**62.7**	52.9–72.4	**60.9**	50.7–71.2
55–64	**78.8**	75.5–82.2	**79.0**	74.4–83.6	**78.7**	73.7–83.6	**67.9**	63.8–72.0	**67.1**	61.4–72.7	**68.9**	63.0–74.8	**63.4**	58.9–68.0	**65.2**	59.0–71.3	**61.3**	54.5–68.1
65–74	**75.6**	72.2–79.0	**75.2**	70.3–80.0	**76.0**	71.2–80.7	**66.1**	62.1–70.2	**66.1**	60.3–72.0	**66.2**	60.5–71.8	**60.8**	56.1–65.4	**60.8**	54.0–67.6	**60.7**	54.4–67.1
75–99	**65.1**	60.6–69.5	**67.6**	60.9–74.2	**62.8**	56.8–68.8	**55.5**	50.3–60.8	**60.8**	52.7–68.9	**51.0**	44.1–57.9	**54.7**	48.4–61.0	**61.2**	51.5–71.0	**48.9**	40.8–57.0
Rectum																		
15–44	**87.1**	79.1–95.1	**87.9**	77.8–98.0	**85.7**	72.8–98.5	**73.5**	62.4–84.6	**73.0**	58.1–87.9	**73.6**	57.0–90.3	**60.0**	45.8–74.1	**56.5**	36.4–76.5	**63.7**	44.5–82.9
45–54	**84.8**	78.8–90.8	**81.4**	72.2–90.6	**87.9**	80.3–95.5	**76.0**	68.5–83.5	**72.4**	61.4–83.5	**79.4**	69.3–89.4	**64.1**	54.8–73.4	**59.7**	46.3–73.1	**68.3**	55.7–80.8
55–64	**82.9**	78.8–86.9	**81.0**	75.4–86.6	**85.5**	79.8–91.3	**72.2**	67.0–77.3	**69.5**	62.5–76.5	**76.1**	68.6–83.6	**62.2**	55.9–68.4	**56.5**	48.1–65.0	**70.4**	61.6–79.2
65–74	**78.6**	73.9–83.2	**78.5**	72.3–84.8	**78.6**	71.7–85.5	**65.3**	59.5–71.2	**66.4**	58.5–74.3	**64.2**	55.6–72.8	**60.3**	53.6–67.0	**60.6**	51.3–69.9	**59.9**	50.3–69.5
75–99	**66.0**	59.7–72.3	**66.4**	57.5–75.4	**65.4**	56.5–74.2	**47.1**	39.3–54.9	**51.8**	40.8–62.8	**42.5**	31.6–53.4	**38.2**	29.5–46.9	**40.2**	27.6–52.9	**36.4**	24.8–47.9
Breast																		
15–44	..	.. ..	..	.. ..	..	..	**96.8**	95.8–97.8	..	.. ..	..	.. ..	**93.8**	92.4–95.3	..	.. ..	..	.. ..	**90.8**	89.0–92.7
45–54	..	.. ..	..	.. ..	..	..	**95.9**	94.9–96.8	..	.. ..	..	.. ..	**90.4**	89.0–91.9	..	.. ..	..	.. ..	**86.6**	84.8–88.4
55–64	..	.. ..	..	.. ..	..	..	**94.3**	93.3–95.3	..	.. ..	..	.. ..	**88.7**	87.3–90.2	..	.. ..	..	.. ..	**84.3**	82.5–86.1
65–74	..	.. ..	..	.. ..	..	..	**93.7**	92.4–95.1	..	.. ..	..	.. ..	**89.0**	87.0–90.9	..	.. ..	..	.. ..	**84.6**	82.1–87.1
75–99	..	.. ..	..	.. ..	..	..	**89.3**	86.6–91.9	..	.. ..	..	.. ..	**84.2**	80.5–87.9	..	.. ..	..	.. ..	**81.7**	76.9–86.4
Cervix																		
15–44	..	.. ..	..	.. ..	..	..	**93.3**	90.7–96.0	..	.. ..	..	.. ..	**85.1**	81.0–89.2	..	.. ..	..	.. ..	**83.2**	78.8–87.7
45–54	..	.. ..	..	.. ..	..	..	**89.2**	86.3–92.1	..	.. ..	..	.. ..	**77.6**	73.5–81.6	..	.. ..	..	.. ..	**73.1**	68.6–77.6
55–64	..	.. ..	..	.. ..	..	..	**87.4**	84.0–90.8	..	.. ..	..	.. ..	**68.9**	63.9–73.9	..	.. ..	..	.. ..	**62.6**	57.0–68.1
65–74	..	.. ..	..	.. ..	..	..	**82.4**	77.2–87.5	..	.. ..	..	.. ..	**69.2**	62.6–75.9	..	.. ..	..	.. ..	**60.0**	52.1–67.8
75–99	..	.. ..	..	.. ..	..	..	**69.6**	58.5–80.6	..	.. ..	..	.. ..	**53.7**	40.9–66.5	..	.. ..	..	.. ..	**44.9**	30.9–58.9

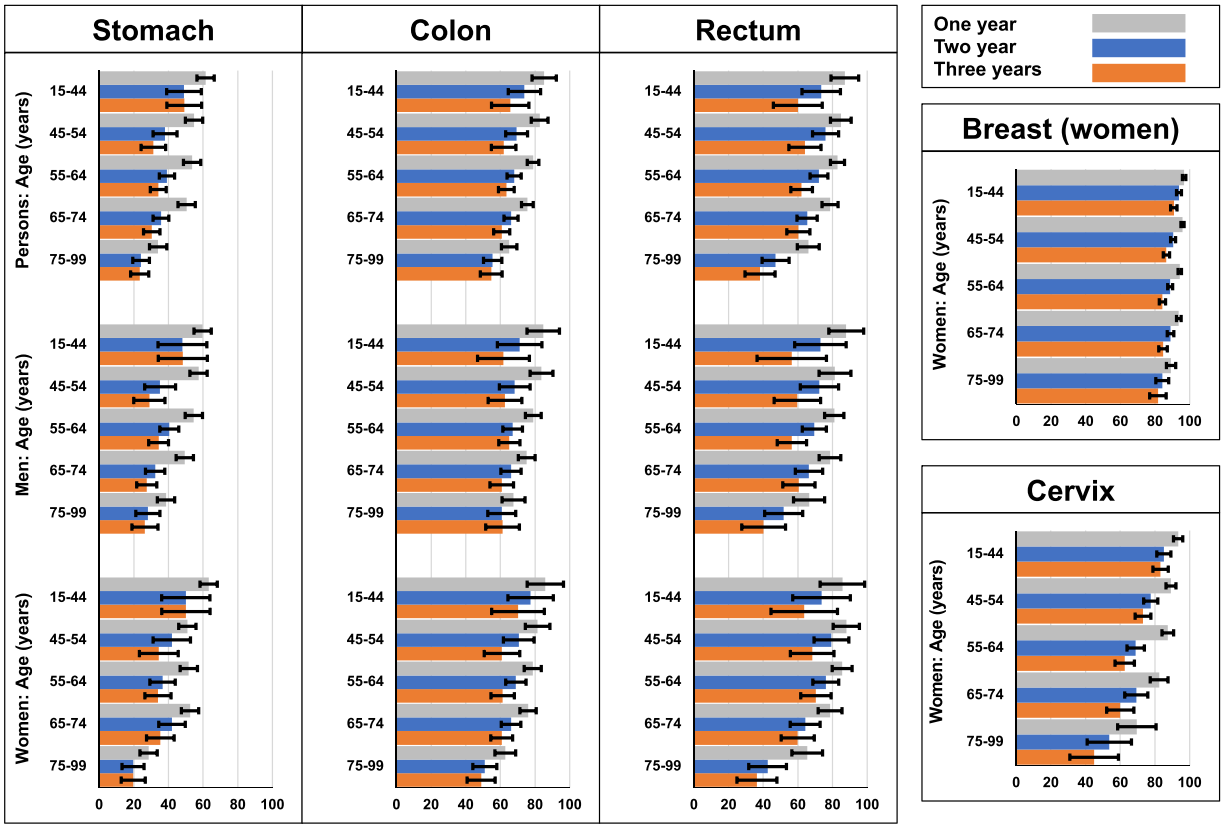

Fig. 1. Net survival (%) at one, two and three years for cancers of the stomach, colon, rectum, breast (women) and cervix: adults (15–99 years) diagnosed in Georgia during 2015–2019, by sex.

large proportion of health expenditure in Georgia, despite expansion in coverage of the UHC programme. Greater involvement of primary care practitioners in cancer care, leading to wider participation in screening programmes and wider population acceptance of cancer treatment, would all be likely to help improve cancer survival in Georgia, as well as reducing the financial burden from cancer drugs.

Stage at diagnosis and treatment data were not available for these analyses. We plan to examine patterns of care and survival by stage at diagnosis for each cancer in another manuscript.

Establishment of the Population-Based Cancer Registry has enabled the first examination of population-based cancer survival in Georgia. Maintenance of the registry will facilitate continued surveillance of both cancer incidence and survival from cancer, to monitor and help improve the effectiveness of national strategies for cancer prevention and treatment.

Ethics approval and consent to participate

The Cancer Survival Group maintains approval for processing sensitive personal data for the CONCORD programme from the UK's statutory Health Research Authority (HRA; reference ECC 3–04(i)/2011; last update 27 August 2020), the National Health Service Research Ethics Service (11/LO/0331; 26 May 2020), and the Ethics Committee of the London School of Hygiene & Tropical Medicine (12171; 7 September 2020).

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CRediT authorship contribution statement

CA, MM and **MPC:** Conceptualization, Methodology, Formal analysis, Writing – original draft. **NM** and **AG:** Conceptualization, Writing – review & editing. **MK, KK**, **SZ** and **RA:** Writing – review & editing.

Contributors

CA, MM and **MPC** drafted the protocol. **NM** and **AG** provided the data. **MM** prepared the life tables. **MM, CA** and **MPC** had access to the data. **MM** performed the data preparation, quality control and analyses. All authors checked the results. All authors had access to the results of all steps of data preparation, quality control and analyses, and contributed to interpretation of the findings. All authors contributed to writing the manuscript and approved the version to be published.

Declaration of interests

The authors declare no conflicts of interest.

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