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Title	International disruptions to cancer diagnosis and stage at presentation during the COVID-19 pandemic in 2020: an International Cancer Benchmarking Partnership (ICBP) population-based study
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International disruptions to cancer diagnosis and stage at presentation during the COVID-19 pandemic in 2020: an International Cancer Benchmarking Partnership (ICBP) population-based study

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Summary

Background The COVID-19 pandemic had an impact on cancer services globally. There is a crucial need to understand how the incidence and stage of major cancer types were affected internationally. We aimed to assess these metrics in seven countries within the International Cancer Benchmarking Partnership.

Methods This population-based study used data on 2·6 million patients diagnosed with primary cancers of the colon, rectum, lung, prostate, female breast, ovary, and melanoma of the skin, between Jan 1, 2015, and Dec 31, 2020. Data were collected from cancer registries in 18 jurisdictions from seven countries participating in the International Cancer Benchmarking Partnership; Australia, Canada, Denmark, Ireland, New Zealand, Norway, and the UK. The main outcomes of monthly cases and age-standardised incidence rates by site during the pandemic (April 1 to Dec 31, 2020) were compared with predictions for the same year based on pre-pandemic trends (Jan 1, 2015, to Dec 31, 2019).

Findings Between April 1, and Dec 31, 2020, 55 713 (16%) of 347 666 expected cases were predicted to be missing, with the largest deficits seen for prostate cancer (24%), female breast cancer (18%), and melanoma (18%), and the smallest deficits seen for ovarian (4%) and lung cancer (8%). The largest difference between observed and predicted incidence rates for prostate cancer was seen in the UK (164·9 per 100 000 person-years predicted *vs* 101·4 per 100 000 person-years observed) and the smallest difference seen in Norway (164·1 *vs* 168·4). Reductions in incidence were greatest from April 1, to July 31, versus from Aug 1, to Dec 31, in 2020. The percentage deficits between observed and predicted cases were 54% (UK) and 36% (Ireland) for prostate cancer, 40% (UK) and 34% (Ireland) for breast cancer, and 40% (UK) and 35% (Canada) for melanoma.

Interpretation The pandemic's greatest impact was during the first few months of societal lockdowns in 2020 when barriers in access to health care were greatest. Further research is needed to understand whether patients with a missed diagnosis were diagnosed at a later date and if they presented at a later stage.

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Introduction

To date, there have been over 7·1 million COVID-19 deaths reported worldwide.[1] The resulting strain on health systems, compounded by widespread lockdowns, had a profound effect on cancer services across the continuum.[2,3] Restrictions on health-care access and

Research in context

Evidence before this study

The COVID-19 pandemic had a global impact on cancer services, including disruptions to cancer diagnostic and screening services. We searched PubMed from March 1, 2020, to March 25, 2025, for population-based studies containing the search terms "COVID-19" AND "cancer" AND "incidence" AND "stage" AND (("colon") OR ("rectum") OR ("lung") OR ("melanoma") OR ("breast") OR ("ovary") OR ("prostate")). The search was limited to the English language. Studies were considered if they investigated the effect of COVID-19 on cancer incidence and stage at diagnosis. Studies using population-based cancer registry data have reported observed changes in cancer incidence linked to COVID-19 compared with pre-pandemic years. One study compared cancer incidence rates and stages during 2020–21 to pre-pandemic rates across the Nordic countries. The investigators reported declines in rates, with variations across countries dependant on cancer type.

Added value of this study

As part of the International Cancer Benchmarking Partnership (ICBP), this commissioned COVID-19 research project benchmarks observed versus predicted differences in incidence rates of seven cancers (colon, rectum, lung, melanoma, breast, ovary, and prostate) in seven countries (Australia, Canada, Denmark, Ireland, New Zealand, Norway, and the UK) during the first year of the COVID-19 pandemic. Data from high-quality population-based cancer registries were extracted at the jurisdiction level, building on the expertise and the robust processes and methodologies applied in previous ICBP projects, including a comprehensive assessment of data quality and subsequent data harmonisation for maximum data comparability. This study provides a unique opportunity to investigate the international effect of COVID-19 on cancer incidence and stage at diagnosis and the minimal and maximal impacts observed across countries and jurisdictions.

Implications of all the available evidence

We predicted that 16% fewer cancer cases were diagnosed during the COVID-19 period of 2020 (April to December) compared with those expected based on pre-pandemic years. The largest reductions in cancer incidence were found in the initial pandemic period (April to July), when stringent societal lockdowns were implemented. The effect on cancer incidence varied by country and cancer type, with prostate, female breast, and melanoma cancer most affected. The degree of catch-up in observed counts and rates to those expected varied considerably. An additional impact on stage at diagnosis was found, notably for early-stage breast cancers. This international population-based cancer registry study highlights the crucial importance of strengthening health systems resilience and maintaining cancer service delivery to mitigate future crises. The effect of COVID-19 on cancer incidence and short-term and long-term mortality and survival in the years to follow needs further study.

capacity were unprecedented in many countries, disrupting essential cancer services. Diagnostic procedures, screening programmes, and treatment[4,5] were frequently delayed or postponed. Additionally, individuals were deterred from attending health services for fear of contracting or spreading SARS-CoV-2. However, societal lockdown measures and public health recommendations varied between and within countries, and diverse strategies were adopted to ensure continuity of cancer diagnosis, treatment, and care.

Early evidence indicated a decline in cancer diagnoses during the COVID-19 pandemic compared with pre-pandemic levels in many countries.[6–11] The magnitude and duration of these declines varied by country and cancer type, with the most pronounced reductions seen for melanoma, breast, colorectal, and prostate cancer, and other major cancer types.[6,12] Adverse effects on stage at diagnosis were reported, with an increase in late-stage lung cancer cases in the UK.[13] However, the extent to which this shift reflected a true increase in advanced disease versus a relative reduction in early stage diagnoses remains unclear.

To date, an international population-based comparison of the pandemic's effect on cancer incidence has not been conducted. This study, part of the International Cancer Benchmarking Partnership (ICBP), aimed to address this gap by examining changes in incidence and stage at diagnosis during the first year of the pandemic across seven cancer types, spanning 18 jurisdictions in seven countries and three continents.

Methods

Study design

For this population-based study, patient-level data on primary cancers diagnosed between Jan 1, 2015, and Dec 31, 2020, were obtained from cancer registries in 18 jurisdictions from seven countries participating in the ICBP that have high-quality data and universal access to health care: Australia (New South Wales, Victoria, and Western Australia), Canada (Alberta, British Columbia, Manitoba, New Brunswick, Ontario, Prince Edward Island, and Saskatchewan), Denmark, Ireland, New Zealand, Norway, and the UK (England, Scotland, Wales, and Northern Ireland). We focused on five invasive cancer types: colon (ICD-10 C18), rectum (ICD-10 C19–20), lung (ICD-10 C33–34, including trachea and bronchus), female breast (ICD-10 C50), and ovary (excluding borderline cancers) including peritoneum and fallopian tube (ICD-10 C48·1–2, C56, C57·0). Melanoma of the skin (ICD-10 C43) and prostate (ICD-10 C61) cancer were also included as both cancers frequently rely on primary care referrals or opportunistic screening. These pathways might have been particularly affected by reduced access to primary care services and

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increased patient hesitancy, and could offer additional insights into the broad impact of health system functioning. Ethical approval was obtained from each participating registry (if required) and from the International Agency for Research on Cancer (IARC) Ethics Committee (reference IEC 21-45).

Information on pathological and clinical stage (grouped TNM stage and individual T, N, and M elements), Surveillance, Epidemiology and End Results programme (SEER) summary stage 2000 (SEER summary staging), or both were obtained for colon, rectal, lung, breast, and ovarian cancers. Stage information was converted to one common system by mapping individual T, N, and M elements to SEER summary staging (local, regional, and distant) using previously developed algorithms.[14–16] To interpret fluctuations of cancer incidence, key government and health-care databases were reviewed, with dates of societal lockdowns and postponement in cancer screening services during the pandemic extracted for each jurisdiction and cross-checked with registry local leads. Biological sex was provided by the cancer registries and used to inform analyses of sex-specific cancers. Data on race was not collected.

Following a call for data, cancer registries that were confident their data were complete for 2020, and that underwent rigorous data quality checks, as described previously,[17] were included in the study. In summary, data quality indicator tables were constructed to identify specific issues for feedback to individual registries for resolution. Cancer registry staff were involved from the outset of the project, with regular meetings held to discuss data extraction, quality assurance, data harmonisation, analysis, and results. The process of data collection and harmonisation is in the appendix (p 27). To assess potential disruptions in the registration of new cancer cases, monthly distributions of the sources of diagnostic information (also known as the basis of diagnosis) were examined in 2020 and compared with 2019.

See Online for appendix

Statistical analysis

New cancer cases diagnosed during 2020 were compared with those expected using a log-linear annual percentage change model of truncated age-standardised rates (ASRs). Specifically, truncated annual age-standardised incidence rates per 100 000 person-years were calculated by jurisdiction, cancer site, and sex for diagnoses between Jan 1, 2015, and Dec 31, 2019, for patients aged 25 years and older using the world standard population.[18] The estimated annual percentage change (APC) was calculated and applied to the sex-specific and age-specific rates per jurisdiction and cancer site in 2019 to derive the predicted rate for 2020. This rate was then applied to the person-years in 2020 to predict total number of cases by cancer site and sex in 2020. Proportion of cases by month during 2015–19 were applied to the predicted number of cases for 2020 to obtain the predicted cases and ASRs, with 95% CIs, by month. Annual 95% CIs were not estimated as the primary focus was temporal variation at the monthly level. The observed number of monthly new cancer cases and ASRs in 2020 were compared with the predicted monthly cases and rates for 2020, by country, jurisdiction, and cancer type. Data were grouped into two categories, April 1 to July 31, and Aug 1 to Dec 31, relating to fluctuations of societal lockdowns.

Due to potential differences in the effect of COVID-19 and related societal measures on cancer diagnoses (and co-morbidities) by age group, we also report the percentage change in observed and predicted cases in 2020 for patients younger than 75 years and in those aged 75 years or older at diagnosis. The distribution of observed cases by stage between April 1 and Dec 31, 2020, was compared with distributions between April 1, and Dec 31, in 2018 and 2019. Monthly stage-specific ASRs were examined and compared across the same years, stage-specific analysis was restricted to cancers that were included in previous ICBP stage investigations (ie, excluding prostate and melanoma). Two jurisdictions where stage information was not provided (Western Australia, 100% missing or unknown) or remote analysis not performed (Scotland, UK) were excluded, leaving 16 jurisdictions contributing to the stage-specific analyses.

Sensitivity analyses to assess the robustness of our predictions model was carried out on jurisdictions that had available data in-house by (1) using APC rates for three broad age-groups (25–49 years, 50–74 years, and 75 years and older) and (2) using cases in 2019 to predict 2020 cases and ASR (ie, without applying APC of 5 years). Data were submitted through a secured portal at the IARC and handled according to data protection regulations. Due to data sharing regulations, remote analysis was conducted for Denmark, Norway, and Scotland. All analyses were performed using Stata (version 17.0), with R (version 4.3.1) used for remote analyses.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

In total, 2 578 290 new cancer cases diagnosed between Jan 1, 2015, and Dec 31, 2020, in the 18 jurisdictions were included in the study. Data quality indicators for each jurisdiction are provided in the appendix (pp 5–9). Similar levels of quality were observed in pre-pandemic years and 2020. Some increases in the proportion of death certificate or autopsy only cases and decreases in microscopically verified only cases were observed in some jurisdictions during 2020. The basis of diagnosis

for cancers recorded in registries were largely similar during 2019 and 2020, with a slight decrease in pathological diagnoses in April, 2020 (appendix p 28). An increase in clinical diagnoses and a reduction in histological diagnoses were also seen most notably between April 1, and May 31, 2020 in the UK jurisdictions.

Between April 1, and Dec 31, 2020, 347 666 new cancer cases for seven cancer sites were predicted, but only 291 953 cases were observed, a shortfall in incidence of 55 713 cases (16%). Similarly, observed ASRs were lower than those predicted (table; figure 1), with reductions varying across cancer types and studied countries. The largest gap in incidence between April 1 and Dec 31, 2020, was seen for prostate cancer, with an overall decrease in cases of 24%. The largest rate differences were noted in the UK (164·9 per 100 000 person-years [predicted] *vs* 101·4 per 100 000 person-years [observed]), whereas rates remained stable in Norway (164·1 per 100 000 person-years [predicted] *vs* 168·4 per 100 000 person-years [observed]). Large differences were noted for female breast cancer, with an overall decrease of 18% in cases across countries, with rates ranging from 189·8 per 100 000 person-years (predicted) and 139·3 per 100 000 person-years (observed) in Ireland to 171·3 per 100 000 person-years (predicted) and

	2020 predicted		2020 observed		Percentage change in predicted *vs* observed cases 2020*			Missed cases (April 1, to Dec 31)
	Cases	ASR per 100 000 person-years	Cases	ASR per 100 000 person-years	April 1, to July 31	Aug 1, to Dec 31	April 1, to Dec 31	
Colon								
Australia	5387	39·2	4907	35·8	–17%	–3%	–9%	480
Canada	8096	34·1	7337	31·2	–22%	1%	–9%	759
Denmark	2412	42·1	2422	42·6	–7%	6%	0%	–10
Ireland	1371	37·0	1131	30·2	–34%	–4%	–18%	240
New Zealand	1698	41·8	1683	42·2	–4%	1%	–1%	15
Norway	2426	49·9	2513	51·0	3%	4%	4%	–87
UK	23 931	38·0†	20 588	33·0†	–29%	–2%	–14%	3343
Total	45 322	..	40 581	..	–23%	–1%	–10%	4741
Rectum								
Australia	2575	21·6	2320	19·6	–17%	–4%	–10%	255
Canada	3856	18·4	3312	15·9	–28%	–3%	–14%	544
Denmark	1062	20·9	1003	19·5	–14%	1%	–6%	59
Ireland	692	20·5	548	16·3	–32%	–12%	–21%	144
New Zealand	908	25·6	841	23·7	–10%	–6%	–7%	67
Norway	982	22·9	1066	24·8	–7%	21%	9%	–84
UK	11 347	20·8†	9067	16·8†	–39%	–5%	–20%	2280
Total	21 422	..	18 157	..	–30%	–3%	–15%	3265
Lung								
Australia	6953	49·7	6555	46·5	–6%	–6%	–6%	398
Canada	14 694	59·0	13 390	53·9	–14%	–5%	–9%	1304
Denmark	3791	68·3	3804	68·9	–3%	3%	0%	–13
Ireland	2206	59·9	1928	52·8	–12%	–13%	–13%	278
New Zealand	1832	46·1	1877	46·6	–1%	5%	2%	–45
Norway	2597	54·5	2501	52·1	–10%	2%	–4%	96
UK	37 802	58·0†	34 029	52·1†	–19%	–3%	–10%	3773
Total	69 875	..	64 084	..	–15%	–3%	–8%	5791
Melanoma								
Australia	7021	58·4	6238	51·5	–21%	–4%	–11%	783
Canada	5946	28·3	4723	22·6	–35%	–8%	–21%	1223
Denmark	2247	55·0	2117	52·2	–6%	–5%	–6%	130
Ireland	1025	31·2	922	27·7	–25%	2%	–10%	103
New Zealand	2076	58·5	1853	52·1	–19%	–5%	–11%	223
Norway	2060	52·0	2022	50·6	–10%	5%	–2%	38
UK	14 334	29·8†	10 515	21·9†	–40%	–16%	–27%	3819
Total	34 710	..	28 390	..	–30%	–9%	–18%	6320

(Table continues on next page)

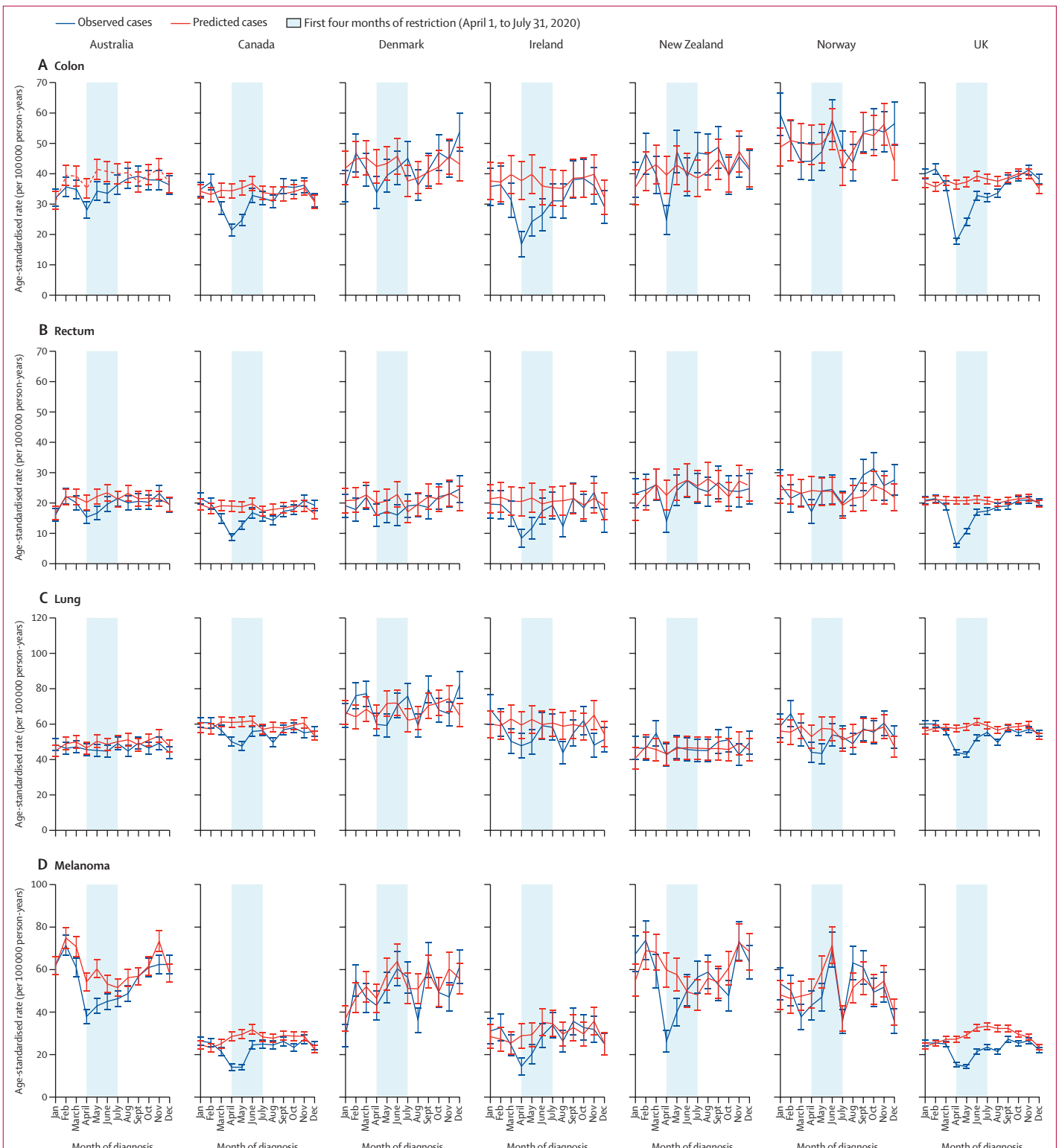
	2020 predicted		2020 observed		Percentage change in predicted vs observed cases 2020*			Missed cases (April 1, to Dec 31)
	Cases	ASR per 100 000 person-years	Cases	ASR per 100 000 person-years	April 1, to July 31	Aug 1, to Dec 31	April 1, to Dec 31	
(Continued from previous page)								
Female breast								
Australia	9736	175·6	8827	159·3	−21%	0%	−9%	909
Canada	16 948	170·5	14 025	142·6	−33%	−4%	−17%	2923
Denmark	3954	183·5	3745	174·3	−14%	1%	−5%	209
Ireland	2927	189·8	2207	139·3	−34%	−17%	−25%	720
New Zealand	2709	171·3	2604	165·9	−19%	8%	−4%	105
Norway	3088	174·5	2758	154·4	−24%	−1%	−11%	330
UK	43 728	183·2†	34 102	142·7†	−40%	−7%	−22%	9626
Total	83 090	..	68 268	..	−34%	−5%	−18%	14 822
Ovary								
Australia	774	12·6	782	12·9	2%	1%	1%	−8
Canada	1679	16·3	1680	16·5	−8%	7%	0%	−1
Denmark	402	16·6	440	18·4	14%	6%	9%	−38
Ireland	296	17·9	362	22·5	15%	29%	22%	−66
New Zealand	221	12·7	243	14·4	12%	8%	10%	−22
Norway	320	16·5	267	13·6	−16%	−17%	−17%	53
UK	5095	19·0†	4659	16·7†	−17%	−2%	−9%	436
Total	8787	..	8433	..	−10%	1%	−4%	354
Prostate								
Australia	12 395	200·0	11 480	185·5	−10%	−5%	−7%	915
Canada	13 537	123·7	11 363	103·1	−30%	−5%	−16%	2174
Denmark	3370	129·7	3317	125·3	−15%	8%	−2%	53
Ireland	3269	205·7	2684	169·0	−36%	−4%	−18%	585
New Zealand	3556	204·8	3117	179·2	−18%	−8%	−12%	439
Norway	3550	164·1	3663	168·4	−5%	10%	3%	−113
UK	44 782	164·9†	28 416	101·4†	−54%	−22%	−37%	16 366
Total	84 460	..	64 040	..	−38%	−13%	−24%	20 420
Total	347 666	..	291 953	..	−28%	−6%	−16%	55 713

Data are n, unless otherwise stated. ASR=age-standardised rate. *Data are grouped into two categories, April 1, to July 31, 2020 and Aug 1, to Dec, 31, 2020, which correspond to fluctuations of societal lockdowns. †ASRs for UK combined excludes Scotland as data could not be provided to allow for this combined calculation. Negative missed cases indicate that the observed number of cases exceeded the number predicted by the model, suggesting there were no missed cases during this period.

Table: **Number of new cases diagnosed and ASRs (per 100 000 person-years) during April 1 to Dec 31, 2020 (predicted and observed), and percentage change in observed cases compared with predicted cases in 2020 by cancer site and country**

165·9 per 100 000 person-years (observed) in New Zealand (table). Of note, the incidence rates of ovarian cancer was largely unchanged across all countries during the comparative periods.

The greatest reductions in observed rates and cases were seen in the initial months of societal lockdowns (April 1 to July 31, 2020), with variations according to cancer site. A large percentage change decrease in cases was noted for prostate (38%), breast (34%), rectum (30%), melanoma (30%), and colon (23%), and lesser decreases were noted for lung (15%) and ovary (10%). Full results are presented in the table, figure 1, and in the appendix (pp 29–49). Substantial reductions in observed rates were found for colon and rectal cancer incidence rates in some countries (Australia, Canada, Ireland, and UK) and little differences in others (Denmark, New Zealand, and Norway). Observed lung cancer rates were lower but not markedly different than predicted. Melanoma rates were markedly lower than predicted during the initial lockdown months in Australia, Canada, New Zealand, Ireland, and the UK. Although a rapid return within 4 months to expected levels was observed in New Zealand and Ireland, with rates similar to the pre-pandemic period, a prolonged reduction in melanoma rates for the remainder of 2020 was observed in the UK. Similar observations were found for prostate cancer, with an 18% reduction in new cases in New Zealand from April 1 to July 31, 2020, and a rapid recovery compared with a 36% reduction in new cases in Ireland and a 54% reduction in new cases and a continued deficit for



(Figure 1 continues on next page)

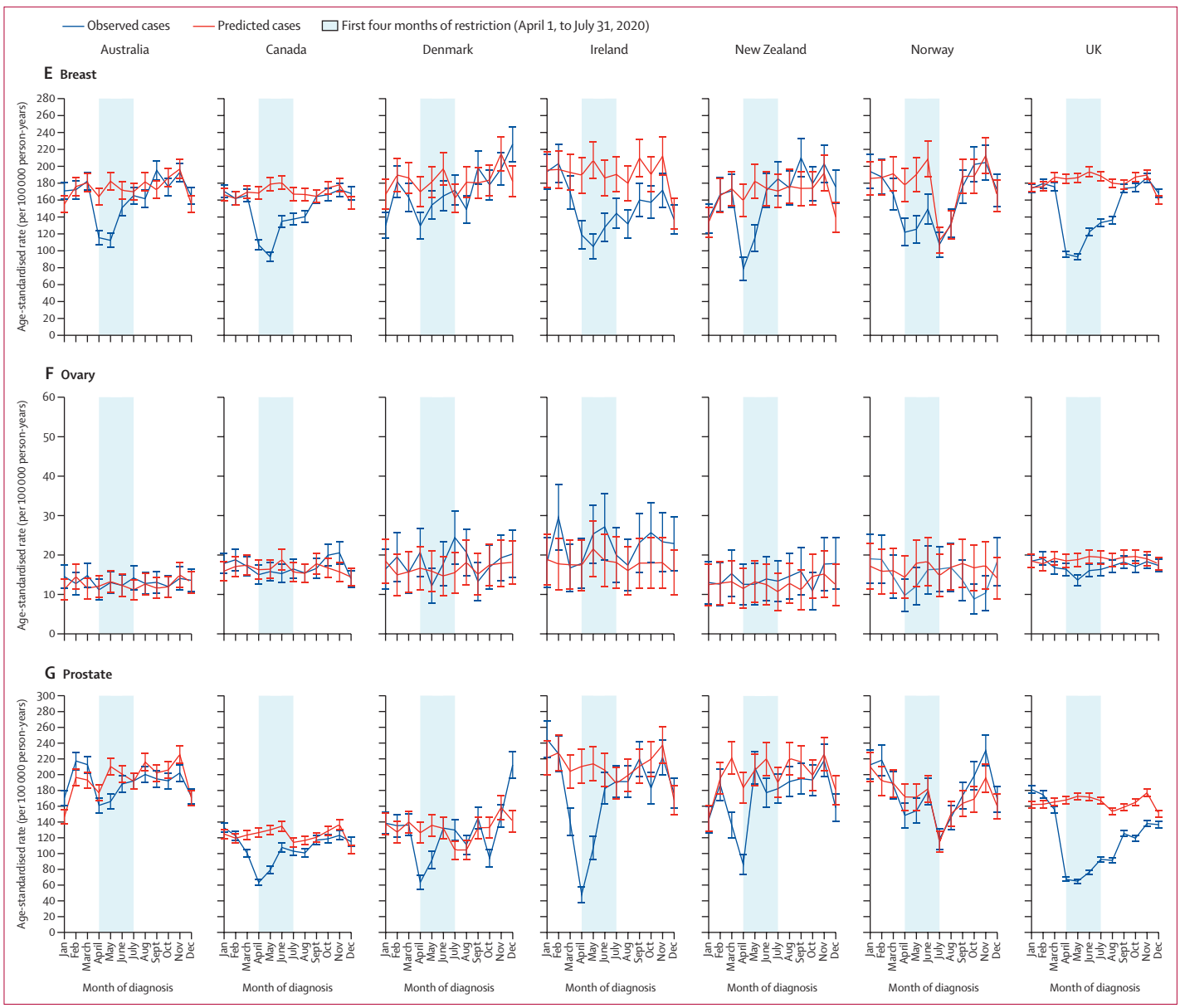


Figure 1: **Observed and predicted incidence rates (age-standardised) by month of diagnosis by cancer site and country in 2020**
Observed cases and predicted cases based on previous 5 years for cancer of the colon (A), rectum (B), lung (C), melanoma (D), breast (E), ovary (F), and prostate (G). Australia includes New South Wales, Victoria, and Western Australia; Canada includes Alberta, British Columbia, Manitoba, New Brunswick, Ontario, Prince Edward Island, and Saskatchewan; UK includes Northern Ireland, England, Scotland, and Wales. Error bars represent 95% CI.

the rest of the year in the UK. Compared with the expected rates, observed incidence rates were markedly lower for breast cancer across all seven countries during April 1 to July 31, 2020, with the shortfall of observed cases ranging from 40% in the UK to 14% in Denmark. New cases of female breast cancer and corresponding observed rates remained lower than the expected rate for Canada, Ireland, and the UK beyond these 4 months, while observed incidence recovered to pre-pandemic levels in Australia, Denmark, New Zealand, and Norway. Small magnitudes of change were noted in ovarian cancer incidence in all countries during the first 4 months of lockdown.

The magnitude of the decline in rates varied within countries (appendix pp 10–13, 29–35). Large variations were seen for prostate cancer in Australia, where incidence rates from April 1 to Dec 31, 2020 remained largely unchanged in New South Wales (182·8 per 100 000 person-years predicted *vs* 194·1 per 100 000 person-years observed), compared with large declines in Victoria (221·1 *vs* 168·0). In Canada, observed and predicted prostate cancer rates were

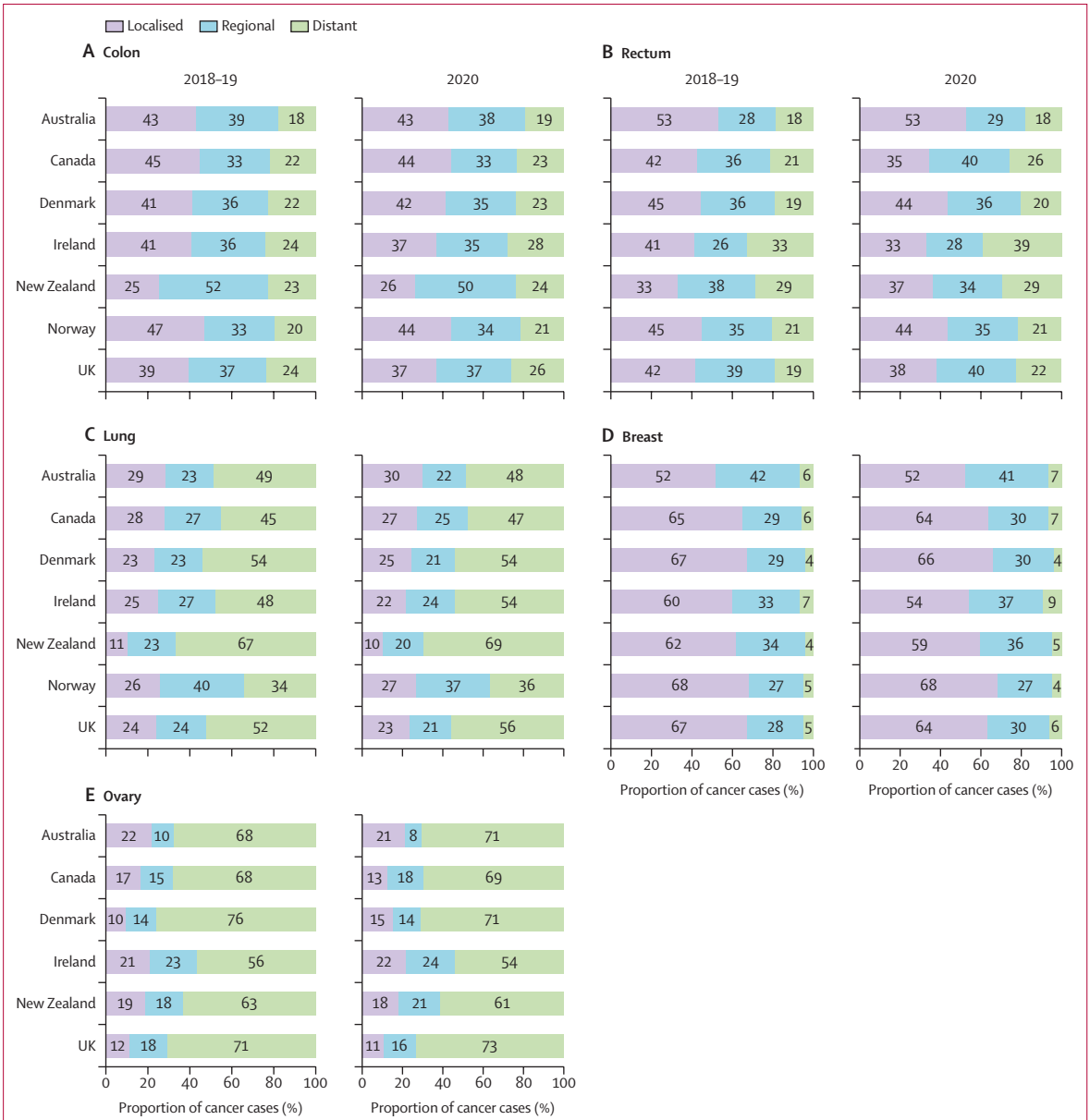
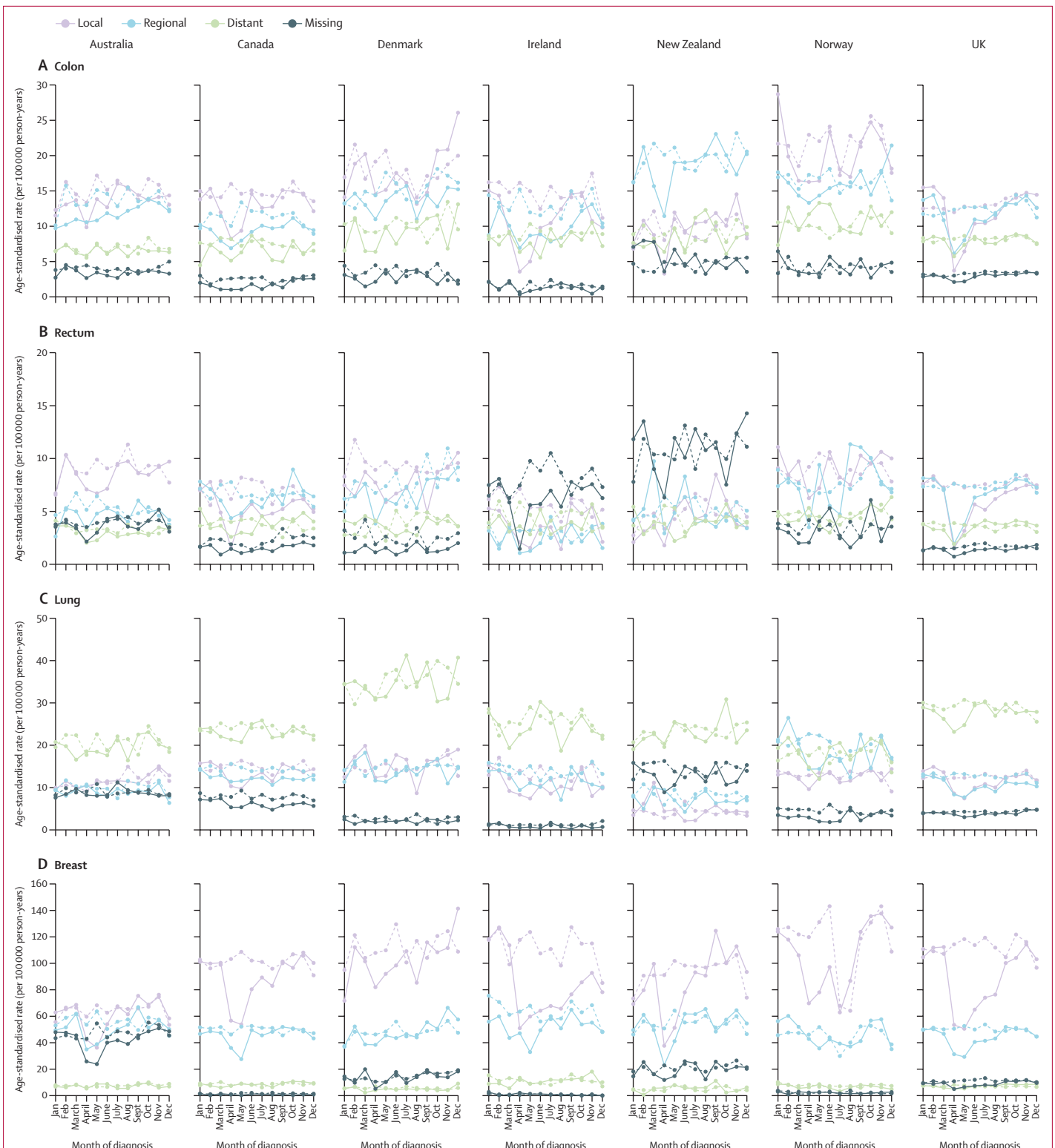


Figure 2: **Stage distribution of mapped Surveillance, Epidemiology and End Results programme summary stage at diagnosis by cancer site and country during April 1, to Dec 31, in 2018–19 and 2020**

Proportions of cases of cancer of the colon (A), rectum (B), lung (C), breast (D), and ovary (E) are shown. Included jurisdictions by cancer site. NSW, Australia: colon, rectum, lung, ovary, and breast. VIC, Australia: colon, rectum, and breast. AB, Canada: breast. BC, Canada: colon, rectum, lung, ovary, and breast. MB, Canada: colon, rectum, lung, ovary, and breast. NB, Canada: colon, rectum, lung, and breast. ON, Canada: lung. PE, Canada: colon, rectum, lung, ovary, and breast. SK, Canada: colon, rectum, lung, and breast. Ireland: colon, rectum, lung, ovary, and breast. New Zealand: colon, rectum, lung, ovary, and breast. England, UK: colon, rectum, lung, ovary, and breast. Northern Ireland, UK: colon, rectum, lung, ovary, and breast. Wales, UK: colon, rectum, lung, ovary, and breast. Denmark: colon, rectum, lung, ovary, and breast. Norway: colon, rectum, lung, and breast.

similar in Prince Edward Island (119·3 *vs* 117·0), but more substantial differences were seen in Manitoba (149·5 *vs* 132·1), New Brunswick (139·4 *vs* 116·8), and Ontario (112·3 *vs* 90·6). Observed incidence rates of prostate cancer were lower than predicted rates in England (165·2 *vs* 101·2) and Wales (167·5 *vs* 95·2) compared with Scotland (128·0 *vs* 95·5) and Northern Ireland (149·8 *vs* 120·2), although the gap narrowed in all UK jurisdictions over time. Similar patterns were observed for colon, rectal, and breast cancer, with a few exceptions. In Canada, observed breast cancer rates in British Columbia and Ontario remained lower than predicted rates for a longer duration than New Brunswick, which showed a rapid recovery in case numbers, with a 6% decrease in cases contrasting with declines in British Columbia (16%) and Ontario (19%)



(Figure 3 continues on next page)

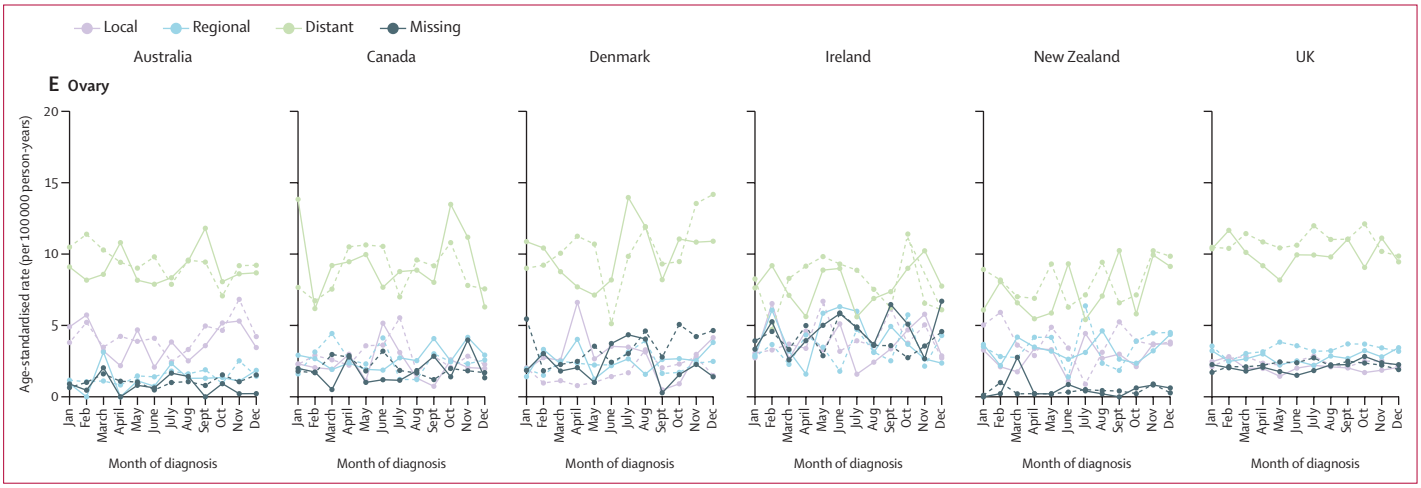


Figure 3: **Stage-specific age-standardised rates by month of diagnosis of mapped Surveillance, Epidemiology and End Results programme summary stage at diagnosis by cancer site and country during 2020 (solid lines) and 2018–19 (dashed lines)**

Age-standardised rates for cancer of the colon (A), rectum (B), and lung (C), breast (D), and ovary (E) are shown.

from April to December, 2020. There were no striking variations in predicted versus observed rates for lung and ovarian cancer during 2020 in any jurisdiction. There were few marked differences in observed and predicted cases between the younger than 75 years and aged 75 years or older age groups (appendix pp 14–22).

The distribution of stage at diagnosis for new cancer cases diagnosed from April 1, to Dec 31, 2018–19, compared with April 1 to Dec 31, 2020 by country are shown in figure 2. Similar distributions were observed in the two periods for all cancer sites. The largest differences between the two periods were observed in Ireland for lung cancer (6% increase in distant stage) and breast cancer (6% decrease in local stage). Little or no change in the proportion of missing stage was observed between the two periods across jurisdictions (appendix p 50). The proportion of patients with unknown or missing stage in 2020 ranged from 4% in Ireland to 14% in New Zealand for colon cancer and from 8% in Denmark to 45% in New Zealand for rectal cancer. Stage-specific ASRs for 2020 versus pre-2020 by month of diagnosis are shown in figure 3. Monthly rates by stage at diagnosis remained similar between the two periods for most cancer sites, with some declines in localised cancers noted. Rates of local and regional colon cancers appeared to be lower in Ireland and the UK, and to some extent Australia and Canada, during 2020 compared with 2018–19. Decreases in the incidence of localised breast cancer was seen across countries during the initial months of the pandemic and were not countered with increases in regional or distant stage cancer, with the UK and Ireland encountering longer times until rates returned to their pre-pandemic levels than the other countries.

Details on societal lockdowns and cancer screening services across jurisdictions during 2020 are provided in the appendix (pp 23–25). All jurisdictions had at least one societal lockdown, beginning in the second half of March, 2020, with variations in duration and scope. Several jurisdictions implemented a second societal lockdown between September and December in 2020. Cancer screening programmes were paused in some jurisdictions with varying durations, with breast cancer screening suspended in Australia (New South Wales and Western Australia), Canada (Ontario and Prince Edward Island), Ireland, Norway, and the UK and colorectal screening halted in Canada and Ireland. Sensitivity analyses to assess the robustness of our predictions model using two alternative methods found concordance with the predicted estimates presented (appendix p 26).

Discussion

To our knowledge, this study is the first to investigate disruptions in cancer diagnosis and stage at presentation during the COVID-19 pandemic internationally. Across the seven cancers investigated, we report that there were 55 713 fewer cases than the 347 666 cases expected during the period from April 1 to Dec 31, in 2020. The shortfall was most pronounced during the first 4 months of the crisis, coinciding with the most severe restrictions on health-care access and social interaction and high hospital occupancy due to COVID-19 in several jurisdictions. Deficits in cancer diagnosis varied by cancer site, country, and jurisdiction, with the largest deficits in expected cases seen for prostate cancer, breast cancer, and melanoma. In jurisdictions where the impact of the pandemic was limited, a return to expected rates was seen within the first 4 months following the onset of the pandemic. For most cancer sites, the distribution of stage at diagnosis remained similar before and during the pandemic, with the most notable deviations seen for early-stage breast cancer.

The varying impact of the COVID-19 pandemic on cancer diagnoses reflects the extent of disruption of

cancer services across the continuum, closely linked to broader health system challenges. The most pronounced effects were seen for cancers associated with high survival and a high likelihood of overdiagnosis (eg, prostate, breast, and melanoma). This finding could imply that long-term excess cancer mortality from the pandemic might not be realised as health systems might have appropriately prioritised resources towards cancers with more urgent clinical needs; however, this hypothesis cannot be confirmed in this study. The small impacts observed for lung and ovarian cancer could be because these are often diagnosed in later stages and patients often present requiring immediate medical attention and, therefore, would still be prioritised for diagnosis and treatment despite pandemic restrictions.

For breast and colorectal cancer, the reductions in cases might partly be attributed to the temporary suspension of population-based screening programmes, implemented to reduce COVID-19 transmission and reallocate health-care resources, with varying timing and extent of recovery. For example in this study, Ireland had a long suspension of breast screening services (over 7 months) and a 25% reduction in diagnoses, in contrast with Australian jurisdictions, where earlier recommencement of breast screening services (within 3 months) and only an 8% reduction in cases was found. For colorectal cancer, little change was observed in Norway, where a national screening programme commenced only after 2020. Other than screening programmes, impacts on clinical services such as reductions in diagnostic procedures, such as colonoscopy, as reported in Australia[19] and England,[20] uptake of faecal immunochemical tests as a triage tool, and changes in patient care-seeking behaviour, probably contributed to the observed shortfall in case detection across most jurisdictions.

Restrictions in access to primary care services and in-person health appointments could have contributed to the case declines in 2020 for melanoma and prostate cancer, both of which are often detected through primary care referral. For example, in New South Wales, Australia, prostate cancer rates remained rather stable, whereas in Victoria, Australia, where longer and stricter lockdowns were implemented, substantial declines were observed.

Other plausible drivers of observed reductions include disruptions in referral pathways and behavioural changes, with widespread efforts to stay at home and heightened fear of infection potentially leading individuals to delay or avoid seeking care for early cancer symptoms.[5] In addition, competing risks, such as COVID-19 mortality, could have also contributed. These factors probably vary by cancer type, with screening-dependent cancers susceptible to reduced referrals and care avoidance, whereas cancers that are often detected incidentally or at a later stage could reflect changes in health-seeking behaviour. In some jurisdictions, such as Norway and Denmark, barriers to care were partly mitigated through proactive efforts to maintain access to primary care services, including the expansion of telemedicine services that were in place pre-pandemic. Notably, both countries reported the smallest reductions in prostate cancer and melanoma diagnoses in 2020.

Disruptions in opportunistic prostate-specific antigen (PSA) screening could have further contributed to the observed variations in prostate cancer incidence across ICBP countries, where, although common,[21] the extent of its use varies between countries. This variation in PSA testing might explain the declines in prostate cancer diagnoses in Ireland and the UK, which have relied heavily on opportunistic screening.

The underdiagnoses of some early stage breast and colon cancers are concerning given the role of timely detection in reducing cancer mortality.[22,23] Similar reductions in early-stage diagnoses have been noted elsewhere.[24,25] However, the majority of breast and colorectal cancers are slow growing, and a timely resumption of screening programmes, along with restored access to general practitioner and specialist care could help mitigate potential excess mortality via early catch-up in diagnoses. Of note, this study did not show a corresponding increase in late-stage diagnoses in 2020. The long-term implications of missed early-stage are uncertain and warrants close monitoring in coming years.[26] Nevertheless, multiple mechanisms could contribute to future survival. Other than delayed diagnosis and upstaging, the direct effects of COVID-19 infection and its potential to exacerbate co-morbidities warrants further investigation.[27]

Among the countries included in this study, New Zealand, Norway, and Denmark (and to some extent Australia for some cancer sites) had a lower impact on cancer diagnoses during 2020 in contrast to the UK, Ireland, and Canada. In New Zealand and Australia, geographical isolation enabled early implementation of border controls and migration restrictions, helping to limit viral transmission while ensuring health services resumed rapidly, thus minimising disruptions to cancer services.[6]

By contrast, the low impact observed in Norway and Denmark—despite their different geographical and policy contexts—suggests that factors beyond geography, such as health system preparedness and policy responses, played a crucial role in mitigating service disruptions. A 2024 investigation by Shah and colleagues[28] highlighted a range of strategies used by countries to maintain cancer service delivery, including the designation of a cancer-specific workforce and the adoption of alternative care delivery models. However, the study also identified systemic weaknesses: governance challenges, funding constraints, and the inability to sustain cancer services amid overwhelmed health systems and physical distancing measures.

Ensuring equity in access to cancer care is a key component of health system resilience. Although our

study did not collect subgroup information, such as socioeconomic status, ethnicity, or the impact of treatment, emerging evidence points to disparities. For instance, one study found a disproportionate decline in lung cancer surgeries in Māori compared with non-Māori cancer patients.[29] Continued surveillance of minority and low socioeconomic status groups will be essential to assess disparities in access to diagnosis and care.

This ICBP-commissioned study offers a unique opportunity to assess the impact of the COVID-19 pandemic on cancer incidence and stage at diagnosis in different health-care settings and to learn from countries that had minimal disruption. The international framework is a key strength, which enables meaningful comparisons across diverse policy and medical contexts, ultimately advancing the overarching goal of improving global health interventions and policy. Although differences in coding and classification systems and cancer registration practice might contribute to the observed variations in cancer incidence and stage across jurisdictions, rigorous procedures have been applied to ensure comparability of the data. The inclusion of jurisdictions with small populations sizes (eg, Prince Edward Island, Canada) should be considered when interpretating incidence rates geographically and over time, as small fluctuations in case numbers can result in seemingly large variations, particularly for uncommon cancers. Additionally, two registries were not included in the stage analysis and several reported resource constraints and delays in completing cancer registrations due to the pandemic. Although some misclassification might have occurred during the mapping of different staging systems, established methodologies were used to minimise inaccuracies, consistent with international standards. Expected rates are model-based estimates and carry uncertainty, depending on factors such as the historical data, variables, and time horizon used. For short-term projections (eg, up to 10 years), population dynamics are the main driver of cancer burden. As we used a short prediction period, with cases from 2015–19 to predict only 1 year ahead, assuming a constant rate across age groups was considered reasonable as large fluctuations in incidence rates were unlikely. Sensitivity analyses using age-specific APC showed agreement between the predicted estimates, supporting the robustness of our approach.

Disruptions to cancer registry operations have been reported[30] and continued investment in disease surveillance is essential to support the future monitoring of cancer control activities worldwide. Although the possibility of registry delays cannot be ruled out, we are confident that the included cancer registry data are complete for 2020 due to our strict quality control. Future work will look at whether the impact of COVID-19 on cancer diagnoses continues in subsequent years. The societal lockdown data presented in this study gives insights into how societal lockdown might have impacted cancer diagnoses across countries. However, we did not formally analyse societal lockdown in relation to cancer incidence and stage because the lockdown information was not integrated in a structured way suitable for formal analysis and was collected via a scoping review of government and jurisdiction sources and inputs from local leads. Incorporating this lockdown data would require additional methodological development that could be explored in future work. Finally, we focused solely on high-income countries; further investigation of the impact of the pandemic on cancer services in low-income and middle-income countries, which might have been more pronounced, is certainly merited.

This comprehensive study, conducted across seven countries with universal health-care coverage, found that 16% expected cancer cases were not diagnosed from April 1 to Dec 31, 2020. The extent of this shortfall varied widely between and within countries, reflecting differences in health-care system resilience, service disruptions, and public health responses. Notably, the greatest deficits were observed for cancers typically detected through screening or opportunistic diagnosis, suggesting widespread disruption across diagnostic pathways.

Ongoing surveillance is essential to determine whether these missing cancer cases were diagnosed later and whether long-term outcomes are affected. A granular understanding as to why some health systems withstood the pandemic's pressures better than others could offer valuable lessons for future crisis preparedness. These findings provide crucial insights for governments and policy makers seeking to strengthen cancer care systems and ensure the continuity of services during future pandemics or other large-scale disruptions.

Contributors

IS and EM designed the study and wrote the first draft of the manuscript. ABa, EM, and OL contributed to data preparation. EM, ABa, IS, OL, JH, SMK, and SL contributed to study analysis, supported by MJR. HAE, DB, ABr, OB, AC, NC, PD, SE, DF, JH, DH, CJ, SMK, EK, SL, QL, CM, AM, HM, DSM, DM, TN, LS, SS, NS-J, LtM, DTu, DTr, GU, SV, MJW, RRW, and BZ contributed to data collection, interpretation of the results, and critically reviewed the manuscript. JB, DC, ML, LtM, DAC, KAMP, and DR contributed to interpretation of the results and critically reviewed the manuscript. All authors commented critically on the manuscript. FB, JB, KCa, KCh, MGG, and ML contributed to the interpretation of the results and finalising the manuscript. All authors had access to the aggregate jurisdictional data reported in the manuscript; ABa, EM, OL, IS, SMK, and SL accessed and verified the data. All authors agreed with the decision to submit for publication. The corresponding author had final responsibility for the decision to submit for publication.

Declaration of interests

ML has received honoraria from Pfizer and MSD unrelated to this work. KCa has investigator-initiated projects with equipment donations from Cephid, Roche, and Microbix unrelated to this work. All other authors declare no competing interests.

Data sharing

De-identified data for this project can be made available upon reasonable direct request to each cancer registry following local ethical and data request approval. Aggregated data as published in this paper will be

made publicly available through the International Agency for Research on Cancer (IARC) Global Cancer Observatory.

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