e-ISSN 2083–4640
ISSN 1507–1367

RESEARCH PAPER

Reports of Practical Oncology and Radiotherapy
2024, Volume 29, Number 2, pages: 131–140
DOI: 10.5603/rpor.99354
Submitted: 14.09.2023
Accepted: 05.02.2024

The impact of the COVID-19 pandemic on incidence gap in screen-detectable cancers: a cohort study in Greater Poland, Poland

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ABSTRACT

Background: The global COVID-19 pandemic has had a significant impact on healthcare systems. This study aimed to assess the incidence gap in screening-detectable cancers in the Greater Poland (Poland) in 2020.

Materials and methods: Data on breast, cervix uteri, and colorectal cancer cases diagnosed from 2010 to 2020 were obtained from the regional cancer registry. Standardized incidence ratios (SIR) and incidence rate differences (IRD) were calculated to estimate the change in incident cancer cases during the pandemic. The number of observed cases was extracted from the registry database. Simple linear regression analysis was used to predict the expected number of incident cancer cases in 2020 and the age-standardized incidence rate based on registry data from the preceding ten years (2010–2019).

Results: In 2020, the registered number of incident female breast cancer cases decreased by 12% [SIR 0.88, 95% confidence interval (CI): 0.88–0.92, observed: 1,848, expected: 2,101], resulting in an IRD of –6.3 per 100 K. The number of registered cervical cancers decreased by 15% (SIR 0.85, 95% CI: 0.73–0.98, observed: 181, expected: 213), with an IRD of –0.8 per 100 K. For colorectal cancer, there was a 16% decrease in new cases among females (SIR 0.84, 95% CI: 0.78–0.90) and a 15% decrease among males (SIR 0.85, 95% CI: 0.80–0.91), resulting in IRDs of –3.04 and –5.29 per 100K, respectively.

Conclusions: The COVID-19 pandemic led to a significant, 15% decrease in newly diagnosed screening-detectable cancer cases in 2020. Further studies are needed to investigate the impact of delayed cancer diagnoses on stage at diagnosis and survival rates.

Key words: cancer; cancer diagnosis; COVID-19; incidence; population-based cancer registry; cancer screening

Rep Pract Oncol Radiother 2024;29(2):131–140

Introduction

The COVID-19 outbreak has considerably affected healthcare systems worldwide [1]. Access to cancer diagnostics [2], as well as cancer early detection programs, were limited [3, 4] due to the allocation of healthcare system resources towards COVID-19 [5, 6] and patients' fear of exposure to the virus in medical facilities. Screening examinations focus on the asymptomatic population; therefore, it was generally accepted to stop or postpone screening activities, especially at the beginning of the pan-

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demic. Lower cancer screening participation rates are expected to influence the incidence of screening-detectable cancers, stage at diagnosis, survival, and long-term mortality.

Reported cancer morbidity in Europe was reduced in 2020 compared to 2019: 6% in Denmark [7], 6% in Sweden [8], 4% in Finland [8], and 6% in Slovenia [9]. Other studies under review report that in the Greater Poland region of Poland, the reduction was more pronounced, with a 20% decrease in the registered number of cancer cases in males and 17% in females.

The first case of COVID-19 in Poland was confirmed on the 4th of March 2020. Six days later, the government implemented various restrictions, which became more severe in the following weeks [10]. Colorectal, cervical, and breast cancer screening programs have been available in Poland for more than a decade and are organized according to site specific European guidelines [11–13] since the beginning of the 21st century (Tab. 1). Although they were not officially suspended during the pandemic, changes in healthcare system organization at the beginning of the pandemic (due to limited resources) and lockdowns led to a reduction in participation rates in all three screening programs [14, 15]. The same trend was observed in other countries like the Netherlands or Belgium [16]. Even before the pandemic, screening participation rates in Poland were low, especially for cervical and colorectal cancer [14, 15].

Little is known about the influence of the COVID-19 outbreak on the incidence of screening-detectable cancers in Poland, especially in the screening age groups. This study aimed to determine the COVID-19-related incidence gap in screening-detectable malignancies in the Greater Poland (Wielkopolskie) region of Poland in 2020.

Table 1. Population-based cancer screening programs in Poland, by cancer site, age range and time interval

Cancer site	Screening program age range	Interval
Breast	50–69	2 years
Cervix uteri	25–59	3 years
Colorectum	50–65 40–49 — for individuals with colorectal cancer among I degree relatives	10 years

Materials and methods

Data sources, study design, and cohort selection

To examine the impact of the COVID-19 pandemic on cancer incidence in Greater Poland, Poland, a population-based open cohort study was conducted.

Data for the study were sourced from the Greater Poland Cancer Registry (GPCR), an official state-funded institution responsible for cancer epidemiology in Greater Poland, one of Poland's most populous administrative regions with a population of 3.51 million in 2020 [17]. The GPCR database encompasses all incident cancer cases among individuals with registered addresses in Greater Poland. Qualified specialists code the data according to the International Classification of Diseases, Tenth Revision (ICD-10), and the International Classification of Diseases for Oncology (ICD-O). The GPCR operates within the framework of the Polish Cancer Registry (PLCR), adhering to the operational guidelines outlined by the PLCR, which are extensively described elsewhere [18]. All recorded cases undergo rigorous validation processes using specific tools aligned with the recommendations of the European Network of Cancer Registries to ensure data quality. The registration system utilizes a unique Polish personal identification number (PESEL) to prevent duplication of patient coding.

Population estimates for Greater Poland during the mid-year were obtained from Statistics Poland [17].

Identification of cancer cases

We included all patients who were registered with a diagnosis of primary malignant neoplasms of the breast (females only), cervix uteri, and colorectum (C50, C53, and C18–20, according to ICD-10) within the period from January 1, 2010, to December 31, 2020. In order to predict the expected number of incident cancer cases in 2020, we included cases diagnosed between January 1, 2010, and December 31, 2019, as a reference. Cases diagnosed between January 1, 2020, and December 31, 2020, were included to assess the impact of the COVID-19 pandemic on the number of registered cancer cases. If a patient had multiple independent incident diagnoses of coexisting neoplasms, we included all pri-

mary malignant neoplasms in the study. The data collected for all registered cases included age at diagnosis, sex, and the corresponding ICD-10 code for the diagnosis.

Statistical analyses

The crude annual incidence rate was calculated as the number of new cases diagnosed per 100,000 person-years. The denominator used for this calculation was the mid-year population, specifically the population size on June 30th of the corresponding year. To facilitate international comparisons, we applied direct age standardization using the World Standard (Segi-Doll) with age-group proportions divided into 18 age groups, following the methodology employed by GLOBOCAN [19].

To quantify the impact of the COVID-19 pandemic on the number of incident cancer cases across all cancer sites, we employed the standardized incidence ratio (SIR). This ratio compares the observed number of new cancer cases to the expected number. The observed case numbers were extracted from the GPCR database. Predictions for the expected number of incident cancer cases in 2020, as well as crude and age-standardized incidence rates (ASR), were generated using simple linear regression analysis. The regression analysis utilized GPCR data spanning a ten-year period prior to the pandemic (2010–2019). For each ICD-10-sex-age-group-predicted variable combination, we developed 204 models (number of cases ~ year; crude incidence ~ year; standardized incidence ~ year). The quality of fit was assessed using the symmetric mean absolute percentage error (SMAPE) [18]. The 95% confidence intervals (CIs) were calculated assuming a Poisson distribution.

To evaluate the COVID-19 pandemic's impact on cancer incidence in 2020, we calculated the incidence rate difference (IRD) by subtracting the expected ASR from the observed ASR. The IRD represents the number of cancer cases per 100,000 person-years that were not identified due to the pandemic.

All statistical analyses were conducted using R (version 4.1.2).

Compliance with ethical standards

Individual-level data from the GPCR can be utilized for statistical purposes and scientific research in compliance with Polish legislation. The GPCR adheres to rigorous regulations to ensure the confidentiality and protection of individual information. This study was conducted following the guidelines outlined in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) to ensure comprehensive and transparent reporting [20].

Results

Screening-detectable cancer incidence by site

In 2020, in Greater Poland, the number of registered incident female breast cancer cases decreased by 12% (SIR 0.88, 95% CI: 0.88–0.92, observed 1,848, expected 2,101; Tab. 2), resulting in an IRD of –6.3 per 100,000 individuals. The number of registered cervical cancer cases also decreased by 15% (SIR 0.85, 95% CI: 0.73–0.98, observed: 181, expected: 213), with an IRD of -0.8 per 100,000 women. Regarding colorectal cancer, there was a 16% decrease in the number of new cases among females (SIR 0.84, 95% CI: 0.78–0.90) and a 15% decrease among males (SIR 0.85, 95% CI: 0.80–0.91), resulting in IRDs of –3.04 and –5.29 per 100,000, respectively.

Screening-detectable cancers by site, age group, and sex

Cancer screening examinations target specific age and sex groups. In Poland, early detection programs for cervical cancer (Pap smear) and breast cancer (mammogram) are aimed at women aged 25–59 and 50–69, respectively. Colorectal cancer screening, based on colonoscopy, is recommended for both sexes aged 50–65 years [21].

Among the screening age group, the number of registered female breast cancer cases only decreased among individuals aged 65-69 (SIR 0.78, 95% CI: 0.69–0.87; Tab. 2). For colorectal cancer cases, a decrease was observed among males aged 55–59 (SIR 0.72, 95% CI: 0.53–0.94), 60–64 (SIR 0.79, 95% CI: 0.64–0.97), and 65–69 years (SIR 0.76, 95% CI: 0.64–0.90). Among females, negative changes were observed in the 60-64 (SIR 0.70, 95% CI: 0.58–0.83) and 65–69 age groups (SIR 0.77, 95% CI: 0.66–0.88). However, no significant negative changes were found in the number of registered cervical cancer cases within the screening group.

Table 2. Observed and expected crude number of new cancer cases, standardized incidence ratio (SIR) with 95% confidence interval (CI) and symmetric mean absolute percentage error (SMAPE), age-standardized incidence rate (ASR), and incidence rate difference (IRD), by sex and age group — Greater Poland, 2020. Screening age groups highlighted in red

Age group	Sex	Observed number of cases	Expected number of cases	SIR (95% CI)	SMAPE %	Observed ASR (W)	Expected ASR (W)	IRD
Breast cancer								
All	Female	1848	2101	0.88 (0.84 to 0.92)	2.40	61.63	67.93	–6.30
10–14	Female	0	0	0.00 (0.00 to 0.00)	0.00	0.00	0.00	0.00
15–19	Female	0	1	0.00 (0.00 to 3.69)	194.02	0.00	0.06	–0.06
20–24	Female	1	0	0.00 (0.00 to 0.00)	140.96	0.09	-0.02	0.10
25–29	Female	10	12	0.83 (0.40 to 1.53)	24.64	0.70	0.80	–0.10
30–34	Female	42	36	1.17 (0.84 to 1.58)	10.41	1.90	1.50	0.40
35–39	Female	62	84	**0.74 (0.57 to 0.95)**	10.84	2.51	3.36	–0.85
40–44	Female	137	147	0.93 (0.78 to 1.10)	5.12	5.88	6.34	–0.46
45–49	Female	174	182	0.96 (0.82 to 1.11)	6.92	8.65	9.86	–1.21
50–54	Female	196	190	1.03 (0.89 to 1.19)	3.76	9.62	10.02	–0.41
55–59	Female	209	222	0.94 (0.82 to 1.08)	4.57	7.88	7.80	0.08
60–64	Female	299	317	0.94 (0.84 to 1.06)	5.87	9.58	9.64	–0.06
65–69	Female	299	384	**0.78 (0.69 to 0.87)**	6.56	7.58	8.71	–1.13
70–74	Female	196	195	1.01 (0.87 to 1.16)	10.62	3.96	5.07	–1.11
75–79	Female	87	139	**0.63 (0.50 to 0.77)**	10.19	1.79	2.67	–0.88
80–84	Female	69	110	**0.63 (0.49 to 0.79)**	7.12	0.76	1.21	–0.44
85+	Female	67	83	0.81 (0.63 to 1.03)	6.25	0.75	0.93	–0.18
Cervical cancer								
All	Female	181	213	0.85(0.73 to 0.98	6.88	6.37	7.16	–0.79
10–14	Female	0	0	0.00 (0.00 to 0.00)	0.00	0.00	0.00	0.00
15–19	Female	0	0	0.00 (0.00 to 0.00)	0.00	0.00	0.00	0.00
20–24	Female	0	1	0.00 (0.00 to 3.69)	168.78	0.00	0.05	–0.05
25–29	Female	3	2	1.50 (0.31 to 4.38)	44.22	0.21	0.17	0.04
30–34	Female	6	7	0.86 (0.31 to 1.87)	27.38	0.27	0.28	–0.01
35–39	Female	15	9	1.67 (0.93 to 2.75)	20.94	0.61	0.34	0.27
40–44	Female	24	18	1.33 (0.85 to 1.98)	27.19	1.03	0.73	0.30
45–49	Female	18	19	0.95 (0.56 to 1.50)	12.34	0.89	1.00	–0.10
50–54	Female	14	19	0.74 (0.40 to 1.24)	16.43	0.69	1.01	–0.33
55–59	Female	14	23	0.61 (0.33 to 1.02)	17.36	0.53	0.84	–0.31
60–64	Female	25	36	0.69 (0.45 to 1.03)	19.38	0.80	1.09	–0.29
65–69	Female	25	37	**0.68 (0.44 to 1.00)**	13.44	0.63	0.79	–0.16
70–74	Female	22	21	1.05 (0.66 to 1.59)	26.60	0.44	0.55	–0.10
75–79	Female	10	8	1.25 (0.60 to 2.30)	18.02	0.21	0.16	0.05
80–84	Female	3	8	0.38 (0.08 to 1.10)	34.32	0.03	0.08	–0.05
85+	Female	2	6	0.33 (0.04 to 1.20)	46.36	0.02	0.07	–0.04
Colorectal cancer								
All	Female	727	869	0.84(0.78 to 0.90)	2.25	18.64	21.67	–3.04
10–14	Female	0	0	0.00 (0.00 to 0.00)	196.26	0.00	0.01	–0.01
15–19	Female	0	0	0.00 (0.00 to 0.00)	192.04	0.00	–0.01	0.01
20–24	Female	1	0	0.00 (0.00 to 0.00)	168.15	0.09	0.00	0.09

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Table 2. Observed and expected crude number of new cancer cases, standardized incidence ratio (SIR) with 95% confidence interval (CI) and symmetric mean absolute percentage error (SMAPE), age-standardized incidence rate (ASR), and incidence rate difference (IRD), by sex and age group — Greater Poland, 2020. Screening age groups highlighted in red

Age group	Sex	Observed number of cases	Expected number of cases	SIR (95% CI)	SMAPE %	Observed ASR (W)	Expected ASR (W)	IRD
25–29	Female	1	1	1.00 (0.03 to 5.57)	51.48	0.07	0.06	0.01
30–34	Female	4	4	1.00 (0.27 to 2.56)	42.66	0.18	0.16	0.03
35–39	Female	12	5	2.40 (1.24 to 4.19)	34.85	0.49	0.19	0.29
40–44	Female	16	17	0.94 (0.54 to 1.53)	18.06	0.69	0.72	–0.03
45–49	Female	23	24	0.96 (0.61 to 1.44)	20.76	1.14	1.28	–0.14
50–54	Female	31	35	0.89 (0.60 to 1.26)	16.99	1.52	1.84	–0.31
55–59	Female	51	71	**0.72 (0.53 to 0.94)**	12.16	1.92	2.47	–0.55
60–64	Female	93	118	**0.79 (0.64 to 0.97)**	5.55	2.98	3.59	–0.61
65–69	Female	131	172	**0.76 (0.64 to 0.90)**	9.76	3.32	3.82	–0.50
70–74	Female	158	139	1.14 (0.97 to 1.33)	11.25	3.19	3.59	–0.40
75–79	Female	81	102	**0.79 (0.63 to 0.99)**	8.00	1.67	1.97	–0.30
80–84	Female	82	107	**0.77 (0.61 to 0.95)**	9.10	0.91	1.17	–0.26
85+	Female	43	77	**0.56** (0.40 to 0.75	8.60	0.48	0.84	–0.36
All	Male	987	1159	**0.85 (0.80 to 0.91)**	3.00	32.37	37.66	–5.29
10–14	Male	0	0	0.00 (0.00 to 0.00)	0.00	0.00	0.00	0.00
15–19	Male	0	0	0.00 (0.00 to 0.00)	186.39	0.00	0.03	–0.03
20–24	Male	1	1	1.00 (0.03 to 5.57)	128.62	0.08	0.05	0.04
25–29	Male	4	3	1.33 (0.36 to 3.41)	76.76	0.27	0.21	0.06
30–34	Male	2	4	0.50 (0.06 to 1.81)	47.28	0.09	0.16	–0.07
35–39	Male	7	6	1.17 (0.47 to 2.40)	16.89	0.28	0.21	0.07
40–44	Male	22	18	1.22 (0.77 to 1.85)	17.04	0.92	0.73	0.19
45–49	Male	21	31	0.68 (0.42 to 1.04)	12.60	1.03	1.63	–0.59
50–54	Male	47	39	1.21 (0.89 to 1.60)	13.97	2.35	2.11	0.24
55–59	Male	95	94	1.01 (0.82to 1.24)	9.33	3.81	3.50	0.31
60–64	Male	132	189	**0.70 (0.58 to 0.83)**	4.18	4.76	6.50	–1.74
65–69	Male	200	261	0.77 (0.66 to 0.88)	5.48	6.23	7.01	–0.78
70–74	Male	228	214	1.07 (0.93 to 1.21)	9.49	6.22	7.41	–1.19
75–79	Male	105	136	**0.77 (0.63 to 0.93)**	6.07	3.39	4.22	–0.83
80–84	Male	82	104	**0.79 (0.63 to 0.98)**	5.02	1.76	2.17	–0.42
85+	Male	41	60	0.68 (0.49 to 0.93)	11.03	1.17	1.72	–0.55

Discussion

The relevance of the study

We conducted a study to assess the impact of the COVID-19 pandemic on the incidence of screening-detectable cancers in Greater Poland, one of the largest administrative regions in Poland. To the best of our knowledge, this is the first study to focus on this group of cancers while considering various age groups. The significance of this study lies in its ability to provide a more accurate assessment of the effects of the COVID-19 pandemic. We contrasted the 2020 data with predicted numbers for that year, rather than relying solely on historical epidemiological data, which allows us to capture the expected changes in cancer incidence over time.

Main findings of the study in the context of Polish literature

One of our key findings was a decrease in the number of newly registered screening-detect-

able cancer cases in 2020. Specifically, we observed a 12% decline in breast cancer cases and a 15% decline in cervical cancer cases among females. For colorectal cancer, there was a 15% reduction in new cases among males and a 16% reduction among females compared to the expected number of cases for that year. The estimates provided by the PLCR, which compared the incidence of cancer cases in 2020 to 2019 for the entire Polish population, showed a 13% decrease in colorectal cancer cases for both males and females. Additionally, they reported an 11% decrease in breast cancer cases among women. However, data on cervical cancer was not presented in that report [22].

Incidence changes by cancer site

A report from Belgium indicated a 44% reduction in new cancer diagnoses in April 2020 compared to April 2019, with an overall annual decline of 6% in 2020 [23]. The initial published reports on the impact of the COVID-19 pandemic on cancer incidence in the screening groups emphasized the need for the healthcare system to prepare for a decrease in new cases and potential stage shifting [16, 24, 25]. These reports demonstrated that there were fewer incident cancer cases in 2020 compared to 2019.

Colorectal cancer

Disruptions related to COVID-19 in accessing diagnostics and treatment in Greater Poland resulted in a 20% decrease in new cases of digestive system cancers among males and a 16% decrease among females in 2020. Literature has reported significant challenges in colorectal cancer diagnostics and treatment in various settings [26, 27]. Smaller declines in incidence were reported in Denmark (10%) [7] and Belgium (11%) [23], while larger decreases were found in Hungary (20%) [28] and Spain (39%) [29]. Delaying colorectal cancer treatment by four months has been shown to increase fatality rates and decrease survival rates [30], so further analysis is needed to assess the pandemic's impact on these metrics. In both 2019 and 2020, 2% of colorectal cancers in Greater Poland were diagnosed through screening in the 50–64 age group [31]. The stage distribution at diagnosis in the Greater Poland region was stable before the pandemic, but there were differences observed between 2019 and 2020 in in situ (1% *vs.* 3%), stage I (19% *vs.* 15%), and stage II (22% *vs.* 24%) cases. An increase in in situ cancers was also reported in Spain [29].

Breast

In Greater Poland, the number of new female breast cancer cases in 2020 was 12% lower than expected. Similar observations were made in other former Eastern Bloc countries, including Hungary (–16%) [28] and Slovenia (–17%) [9]. Western European countries, such as Belgium (6%) [23] and Denmark (8%) [7], had smaller incidence gaps. Notably, in Slovenia, the number of newly diagnosed breast cancer cases in the screening group was only 4% lower in 2020 [9]. Although stage at diagnosis did not show differences in patients diagnosed in 2020 [32], delays in breast cancer diagnosis are expected to impact staging in the years following the pandemic. Significant stage shifts in breast cancer patients diagnosed in 2021 were observed in Greater Poland [33]. Calculations based on data from the Greater Poland Cancer Registry indicate a decrease in the share of breast cancer cases detected through screening in females aged 50–69, from 43% in 2019 to 29% in 2020 [31]. It is important to note that in Poland cancer registries do not exchange data with the screening program IT system, so the actual percentage may differ. Stage at diagnosis showed differences between 2019 and 2020 breast cancer patients in this region, specifically for stage I (36% *vs.* 34%) and stage II (36% *vs.* 38%) cases [31].

Cervix

Our findings revealed a 15% reduction in the number of registered cervical cancer cases, contributing to an overall 17% decrease in new diagnoses of female genital cancers. Even larger decreases were reported in Austria (45%) [34] and Northern England (26%) [35] in 2020. No difference in cervical cancer incidence was reported in Slovenia [9]. Surprisingly, Belgium reported an 11% increase in incidence during the first year of the pandemic [23]. The share of cases diagnosed in Greater Poland through the screening program increased from 4% in 2019 to 9% in 2020 among patients aged 25–59 [31]. An unexpected change in International Federation of Gynecology and Obstetrics (FIGO) stage at diagnosis was reported by the GPCR among cervical cancer patients in 2019 and 2020.

The structure observed before the pandemic remained stable, but there were more in situ cases reported in the first year of the pandemic, along with stage shifts in other groups: in situ (24% *vs*. 36%), stage I (17% *vs*. 14%), stage II (11% *vs*. 9%), stage III (29% *vs*. 24%), and stage IV (20% *vs*. 17%) (31). Similar results were reported in a Romanian study [36].

Cancer incidence gap by sex and age

In Poland, 9% of individuals aged 50 or older chose to forgo healthcare due to the COVID-19 pandemic [37]. This means that two out of three screening programs in Poland could be seriously affected by this circumstance due to the fact that cervical cancer screening is mostly addressed to younger individuals.

Colorectal cancer

The suspension of colorectal cancer screening in the Netherlands for a portion of 2020 led to a decrease in cancer diagnoses in the screening age group for only a few weeks [16]. In Hungary, the decrease was more significant in the population aged 65 and older compared to the younger population (–23% *vs*. –12%) [28]. Spanish results for patients aged 50–69 showed a 19% decline in observed diagnoses, with a 15% drop for all ages [38]. In Greater Poland, a 15% decline in observed diagnoses was found for males, and a 16% decline for females. Among males in the screening age groups, there was a 30% decrease in the 60-64 age group and a 23% decrease in the 65–69 age group. Among females, the decline was observed in three age groups: 28% in the 55–59 age group, 21% in the 60–64 age group, and 24% in the 65–69 age group.

Cervical cancer

Although the observed incidence of cervical cancer decreased in 2020, no changes were found in the screening age groups of 25–59. Other studies on the 2020 cancer incidence data in Greater Poland reported no differences in observed versus expected incidence among children, adolescents, and young adults. The share of screening-detected cervical cancers in the screening age group and the low attendance rate in the program suggest that cervical cancer screening in Greater Poland does not significantly contribute to the diagnosis of this type of malignancy. In contrast to our findings, a Romanian study reported a significant change in the observed number of cervical cancer diagnoses in the screening age group [36]. In Spain, observed diagnoses of cervical cancer decreased by 16% for individuals aged 0–49, 23% for those aged 50–69, and 11% for all ages. An increase of 19% was found among patients aged 70+ [38]. It is also worth noting that patients diagnosed with cervical cancer did not experience disruptions in access to radiotherapy, which is one of the main treatment modalities for this malignancy [39, 40].

Breast cancer

Dutch reports from the early months of the pandemic showed a significant decline in breast cancer diagnoses in the screening age group following the suspension of screening [16]. The decrease was more pronounced in patients aged 65 and older compared to the younger population (–23% *vs*. –8%) in Hungary [28]. In Catalonia, Spain, the decrease was observed for all ages (8%), 0–49 (9%), 50–69 (10%), and 70+ (6%). In the Greater Poland region, we found a 22% decrease in registered breast cancer diagnoses only among the screening age group of 65–69.

Strengths and limitations of the study

The key strength of this study is the utilization of population-based cancer registry data which covers the population of Greater Poland with high completeness due to active registration practices. Another advantage is the comparison with predicted values based on a long history of registry operations, using well-fitted models with acceptable SMAPE. The study is somewhat limited by the lack of a more detailed picture of pandemic-related changes in cancer burden in 2021, as cancer registration typically has a lag time, which is common for cancer registries. Information about screen-detected cancer cases is based solely on cancer notification forms, without data linkage with the screening program database.

Conclusion

In 2020, the number of newly diagnosed screening-detectable cancer cases, regardless of cancer site, was approximately 15% lower than expected,

representing the pandemic-related gap. No changes were found for cervical cancer diagnoses in the screening age groups. The observed incidence was affected in breast cancer diagnoses among individuals aged 65–69. The highest number of screening age groups with a decline in observed cancer diagnoses was found for colorectal cancer, with two out of four age groups in males and three out of four age groups in females showing a pandemic-related gap in incidence. These findings should serve as an introduction for further studies analyzing how delays in cancer diagnosis influence disease stage at diagnosis and survival rates. It is important to investigate if potential long-term effects will be more pronounced in screening age groups. The unexpected increase in colorectal and cervical cancer in situ cases should be verified by the Greater Poland Cancer Registry in terms of data quality.

CRediT authorship contribution statement

Conceptualization: M.T., I.M.M., P.R., W.K.; methodology: I.M.M., M.T.; software: I.M.M.; formal analysis: I.M.M.; data curation: M.T., I.M.M.; project administration: M.T.; writing — original draft: M.T., I.M.M.; writing review and editing: M.T., I.M.M., P.R., W.K.

Conflict of interest

All authors declared no competing interests.

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

The authors declare that generative AI and AI-assisted technologies were not used in the writing process.

Funding

None to declare.

Data sharing

This study complied with all relevant ethical regulations. The data analyzed in this study were obtained from the GPCR and are available upon reasonable request by contacting the GPCR at rejestr.nowotworow@wco.pl and subject to ethical approval in place and material transfer agreements. Following national regulations, these data were exempt from institutional board review. Waiver of ethics approval was deemed unnecessary according to national legislation (reference to the relevant legislation https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180001197). There were no participants in the study, and thus, there was no consent form. Detailed legislative aspects of the GPCR operation are regulated by Polish Law (Dz.U. 2018 poz. 1197).

Acknowledgments

The authors would like to acknowledge the registrars from the Greater Poland Cancer Registry that were responsible for the collection of reliable data for this study.

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