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TRENDS IN CANCER DETECTION AND MORTALITY IN THE ABAY REGION DURING AND AFTER THE COVID-19 PANDEMIC

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Abstract

Background. Malignant neoplasms remain a leading cause of mortality worldwide, and early detection plays a critical role in patient outcomes. The COVID-19 pandemic disrupted oncology services, reducing detection rates and increasing the proportion of late-stage diagnoses. Regions with a history of environmental burden, such as the Abay Region in Kazakhstan, are particularly vulnerable. Given the limited availability of regional data in Central Asia, this study aimed to evaluate changes in the structure, detection, and cancer mortality in the Abay Region between 2020 and 2024 under the influence of the pandemic.

Materials and Methods. Cancer data from the Abay Region (2020-2024) were analyzed using official statistics. The dataset included cancer incidence, staging, and mortality. Data were structured in long-table format and analyzed using Python (pandas, matplotlib, scipy.stats). Annual dynamics were assessed, with comparisons made between pre-pandemic and post-pandemic periods. The proportion of early- and late-stage diagnoses was also calculated. Statistical significance was assessed using the independent samples t-test at $p < 0.05$.

Results. Between 2020 and 2024, 7,732 new cancer cases and 3,090 cancer-related deaths were recorded in the Abay Region. Following the end of the active phase of the COVID-19 pandemic, the number of new cases increased by approximately 26%, advanced-stage diagnoses by 22%, and mortality by 5%. The standardized cancer incidence rate rose from 208.9 to 263.8 per 100,000 population. The share of early-stage detection increased from 20.7% to 29.6%. However, differences in early detection and mortality between pre- and post-pandemic periods did not reach statistical significance. These results underscore the need for continued cancer monitoring and more in-depth research.

Conclusions. The COVID-19 pandemic led to a rise in cancer incidence and a moderate increase in mortality in the Abay Region. An improvement in early detection suggests partial recovery of screening services. The findings highlight the need to strengthen oncology system resilience in times of crisis.

Keywords: *malignant neoplasms, cancer monitoring, oncology services, COVID-19.*

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Резюме

ТЕНДЕНЦИИ ВЫЯВЛЯЕМОСТИ И СМЕРТНОСТИ ОТ ЗЛОКАЧЕСТВЕННЫХ НОВООБРАЗОВАНИЙ В ОБЛАСТИ АБАЙ В ПЕРИОД ПАНДЕМИИ COVID-19 И ПОСЛЕ НЕЁ

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Введение. Злокачественные новообразования остаются одной из ведущих причин смертности в мире, при этом ранняя диагностика играет решающую роль в прогнозе заболевания. Пандемия COVID-19 нарушила работу

онкологической службы, снизив выявляемость рака и увеличив долю поздних стадий. Особенно уязвимыми оказались регионы с историческим экологическим бременем, такие как Абайская область Казахстана. Учитывая недостаток региональных данных в Центральной Азии, данное исследование направлено на оценку изменений в структуре, выявляемости и смертности от онкологических заболеваний в Абайской области в 2020–2024 годах под влиянием пандемии.

Материалы и методы. Анализ онкологических данных в Абайской области за 2020–2024 годы включал оценку заболеваемости, стадии выявления и смертности от рака на основе официальной статистики. Данные были структурированы в формате long table и обработаны с использованием Python (pandas, matplotlib, scipy.stats). Изучалась динамика показателей по годам, сравнение допандемического и постпандемического периодов, а также доли ранних и поздних стадий выявления. Для оценки различий применялся t-критерий Стьюдента при уровне значимости $p < 0,05$.

Результаты. С 2020 по 2024 год в Абайской области зарегистрировано 7 732 новых случая злокачественных новообразований и 3 090 случаев смерти от онкологических заболеваний. После активной фазы пандемии COVID-19 наблюдалось увеличение числа новых случаев примерно на 26%, числа запущенных форм — на 22%, а уровня смертности — на 5%. Стандартизованный показатель заболеваемости злокачественными опухолями увеличился с 208,9 до 263,8 на 100 000 населения. Доля выявления на ранних стадиях выросла с 20,7% до 29,6%, однако различия в раннем выявлении и уровне смертности между допандемическим и постпандемическим периодами не достигли статистической значимости. Эти результаты подчеркивают необходимость дальнейшего мониторинга онкологических показателей и проведения углублённых исследований.

Выводы. Пандемия COVID-19 вызвала рост заболеваемости раком в Абайской области и умеренное увеличение смертности. Отмечено улучшение раннего выявления, что отражает частичное восстановление скрининга. Результаты подчеркивают необходимость укрепления онкологической службы для устойчивости в условиях кризисов.

Ключевые слова: *злокачественные новообразования, мониторинг онкологических заболеваний, онкологическая служба, COVID-19.*

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Түйіндеме

COVID-19 ПАНДЕМИЯСЫ КЕЗІНДЕ ЖӘНЕ ОДАН КЕЙІН АБАЙ ОБЛЫСЫНДА ҚАТЕРЛІ ІСІК АНЫҚТАЛУЫ МЕН ӨЛІМ-ЖІТІМІНІҢ ДИНАМИКАСЫ

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Кіріспе. Қатерлі ісіктер әлем бойынша өлім-жітімнің негізгі себептерінің бірі болып қала береді, ал аурудың болжамына ерте диагностика маңызды әсер етеді. COVID-19 пандемиясы онкологиялық қызметтердің жұмыс істеу жүйесін бұзып, қатерлі ісіктерді ерте анықтау деңгейінің төмендеуіне және аурудың кеш сатыларында анықталу жиілігінің артуына алып келді. Тарихи экологиялық жүктемесі бар өңірлер, соның ішінде Қазақстанның Абай облысы, бұл тұрғыда ерекше осалдық танытты. Орталық Азияда өңірлік деректердің шектеулі болуын ескере отырып, осы зерттеу COVID-19 пандемиясының әсерінен 2020–2024 жылдар аралығында Абай облысындағы қатерлі ісік құрылымы, анықталу көрсеткіштері және өлім-жітімінің өзгерістерін бағалауға бағытталған.

Материалдар мен Әдістер. Абай облысында 2020–2024 жылдар аралығындағы онкологиялық деректерді талдау қатерлі ісік аурушаңдығының, анықталу сатыларының және өлім-жітім көрсеткіштерінің ресми статистика негізінде бағалануын қамтыды. Деректер long table форматында құрылып, Python бағдарламалау тілі (pandas, matplotlib, scipy.stats кітапханалары) арқылы өңделді. Көрсеткіштердің жылдар бойынша динамикасы, пандемияға дейінгі және пандемиядан кейінгі кезеңдердегі айырмашылықтар, сондай-ақ қатерлі ісіктің ерте және кеш сатыларда анықталу үлесі зерттелді. Айырмашылықтарды бағалау үшін Стьюденттің t-критерийі қолданылды, маңыздылық деңгейі $p < 0,05$ ретінде белгіленді.

Нәтижелер. COVID-19 пандемиясы Абай облысында қатерлі ісік аурушаңдығының өсуіне және өлім-жітімнің біршама артуына алып келді. Ерте анықтау көрсеткіштерінің жақсарғаны байқалды, бұл скринингтік

бағдарламалардың ішінара қалпына келуін көрсетеді. Алынған нәтижелер дағдарыс жағдайларында тұрақтылықты қамтамасыз ету үшін онкологиялық қызметті нығайтудың маңыздылығын айқындайды.

Қорытынды. COVID-19 пандемиясы Абай облысында қатерлі ісік аурушаңдығының өсуіне және өлім-жітімнің шамалы артуына себеп болды. Ерте анықтау көрсеткіштерінің жақсарғаны байқалды, бұл скринингтік бағдарламалардың ішінара қалпына келгенін көрсетеді. Зерттеу нәтижелері дағдарыс жағдайларында тұрақтылықты қамтамасыз ету үшін онкологиялық қызметті күшейту қажеттілігін айқындайды.

Түйінді сөздер: *қатерлі ісіктер, онкологиялық көрсеткіштерді бақылау, онкологиялық қызмет, COVID-19.*

Дәйексөз үшін:

Танатаров С., Зейнелова Л., Бекетова Б., Шаймарданов Н., Апсаликов Б. COVID-19 пандемиясы кезінде және одан кейін абай облысында қатерлі ісік анықталуы мен өлім-жітімінің динамикасы // Ғылым және Денсаулық сақтау. 2025. Vol.27 (4), Б. 138-143. *doi 10.34689/SH.2025.27.4.018*

Introduction

Malignant neoplasms remain one of the leading causes of morbidity and mortality worldwide. According to the World Health Organization, cancer was responsible for more than 10 million deaths in 2022, and the global cancer burden is projected to continue rising in the coming decades [10]. One of the key determinants of cancer prognosis and survival is the stage at diagnosis. Early detection significantly improves treatment outcomes and reduces the burden on healthcare systems [1].

The COVID-19 pandemic has had a substantial impact on oncology services globally, including in Kazakhstan. Disruptions in the continuum of care, suspension of screening programs, limited access to diagnostics, and patients' reluctance to seek medical attention contributed to decreased cancer detection and an increase in the proportion of late-stage diagnoses [5,7,9,11]. In Kazakhstan, particularly in regions with vulnerable populations and a legacy of environmental exposure, such as the Abay Region, the consequences of the pandemic may be especially pronounced.

The Abay Region includes territories historically affected by ionizing radiation due to nuclear testing at the Semipalatinsk Test Site. Although this study does not analyze dosimetric or tumor-specific characteristics, the historical context may amplify the medical vulnerability of the local population and highlight the importance of timely cancer detection and monitoring, especially during public health crises such as the COVID-19 pandemic.

While the global literature increasingly addresses the pandemic's impact on oncology care, regional data from Central Asia – and Kazakhstan in particular – remain scarce [1,2]. There is a pressing need for local studies that assess how the structure, detection, and outcomes of cancer care evolved during a global health crisis.

The aim of this study was to assess trends in cancer detection, staging at diagnosis, and cancer-related mortality in the Abay Region between 2020 and 2024, with a particular focus on the impact of the COVID-19 pandemic.

Materials and Methods

The analysis was based on official statistical reports provided by the Center for Nuclear Medicine and Oncology of the Abay Region Health Department. The dataset covered the adult population of the Abay Region over the period from 2020 to 2024 and included the annual number of newly diagnosed malignant neoplasms, standardized incidence and mortality rates (per 100,000 population), the number of newly diagnosed cases by stage (0-I and III-IV), and the absolute number of cancer-related deaths.

The data were compiled in accordance with approved national statistical forms and underwent internal verification within the institution before being included in regional summaries. Aggregation was performed at the annual level, and no individual-level patient information was used in the analysis. No missing values were present in the dataset.

Cancer staging was determined based on information recorded in primary oncological documentation forms, using clinical and morphological data, and classified according to the TNM system in force at the time of diagnosis.

Data processing and graphical visualization were performed using the Python programming language (version 3.11). The pandas library (https://pandas.pydata.org) was used for data manipulation and calculation, while the matplotlib library (https://matplotlib.org) was used for data visualization. Proportional indicators (e.g., share of early-stage or advanced-stage diagnoses) were calculated as the ratio of respective absolute counts to the total number of new cases per year.

Comparative analysis between two time intervals – the pre-pandemic and pandemic period (2020–2021) and the post-pandemic period (2022–2024) – was performed using the independent samples Student's t-test. A p-value of <0.05 was considered statistically significant. Given the limited number of observations (n = 5 years), the test was interpreted as an exploratory tool for identifying potential statistical trends.

Results

From 2020 to 2024, a total of 7,732 new cases of malignant neoplasms and 3,090 cancer-related deaths were registered in the Abay Region. Analysis of indicator trends in the context of the COVID-19 pandemic revealed notable changes in cancer detection and outcomes. As illustrated in Figure 1, a consistent upward trend was observed across all major indicators from 2020 to 2024: the absolute number of new cancer cases increased by nearly one-third, advanced-stage diagnoses grew by 22%, and cancer-related mortality rose by approximately 5%. The most pronounced increase occurred starting in 2022, coinciding with the end of the active phase of the pandemic. The period of 2020–2021, highlighted in grey in the figure, represents the initial stage of the COVID-19 pandemic in Kazakhstan, during which cancer indicators remained relatively stable.

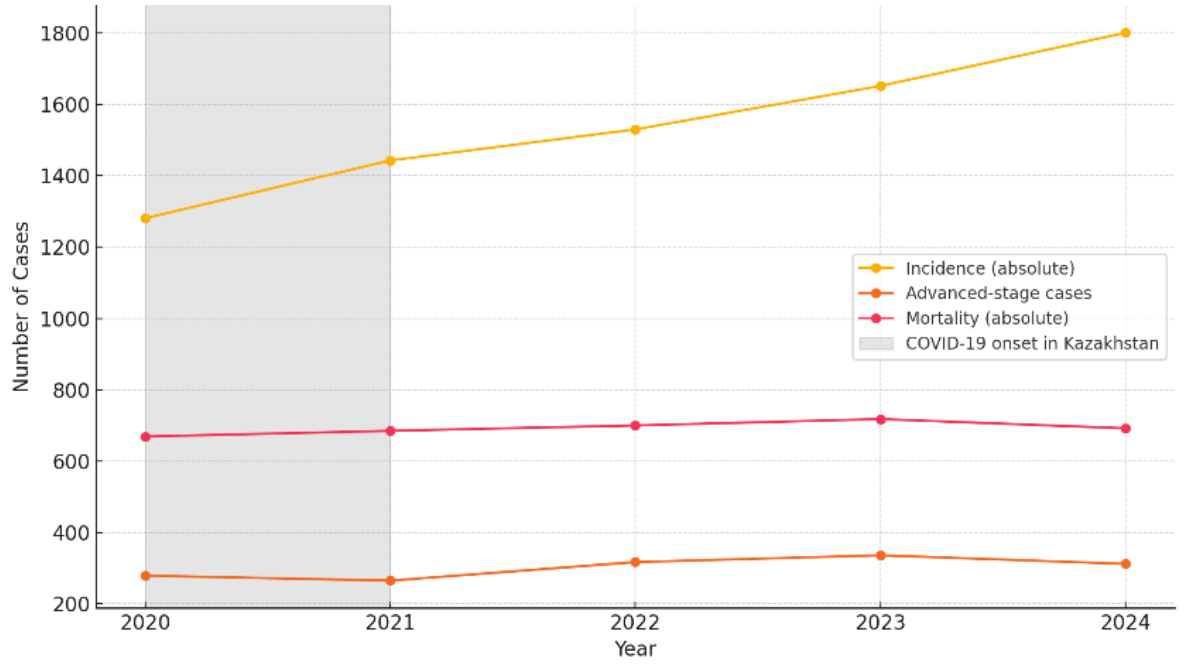

Figure 1. Trends in cancer incidence, advanced-stage cases, and mortality in the Abay region, 2020-2024. The post-COVID period is marked by a visible increase in all major indicators.

The number of newly diagnosed cancer cases increased from 1,281 in 2020 (pre-pandemic period) to an average of 1,608 per year in the post-pandemic period (2022-2024), representing a 25.6% increase. A similar trend was observed in the standardized incidence rate, which rose from 208.9 to 263.8 per 100,000 populations. This may reflect both a true rise in incidence and improved case detection.

The number of advanced-stage cases (stage III–IV or equivalent clinical criteria) slightly decreased in 2021 (265 cases), possibly due to limited access to diagnostic services during the pandemic. However, a marked increase was observed in the post-pandemic years, with an average of 322 advanced cases per year, likely reflecting delayed presentations and late diagnoses.

Cancer-related deaths rose from 669 in 2020 to an average of 703 per year between 2022 and 2024. The standardized mortality rate also increased – from 109.1 to 115.5 per 100,000 populations – potentially indicating a higher proportion of patients diagnosed at later stages. All key annual indicators are summarized in Table 1.

Table 1.

Key Cancer Indicators in the Abay Region, 2020–2024.

Year	New Cases (abs)	Incidence Rate (/100k)	Deaths (abs)	Mortality Rate (/100k)	Advanced Stage (abs)	Early Stage (abs)	Late Stage (abs)
2020	1,281	208.9	669	109.1	279	265	84
2021	1,443	236.4	685	112.2	265	380	75
2022	1,530	251.7	700	115.1	317	418	105
2023	1,652	270.7	716	117.3	347	479	100
2024	1,641	268.9	694	113.7	301	485	95

These values illustrate the post-pandemic increase across incidence, mortality, and staging. Figure 2 further shows the trend in early- and late-stage detection.

Figure 2 demonstrates a gradual increase in the proportion of early-stage diagnoses (stage 0-I), from 20.7% to 29.6% over five years. In contrast, the proportion of late-stage diagnoses (stage III-IV) remained relatively stable at around 5-7%. These changes may reflect the restoration of diagnostic programs following the pandemic and an increase in screening activity.

In addition, a comparative statistical analysis was performed between two time intervals: the pre-pandemic and pandemic period (2020-2021) and the post-pandemic period (2022-2024). The difference in the proportion of early-stage diagnoses between the two intervals did not reach statistical significance ($p = 0.31$, Student's t-test), despite a visually observed increase from 20.7% to 29.6%. Similarly, the change in mortality rate was not statistically significant ($p = 0.13$), although a stable upward trend was evident – from 109.1 to 115.5 per 100,000 populations. These findings underscore the need for continued surveillance and more detailed analysis using larger datasets.

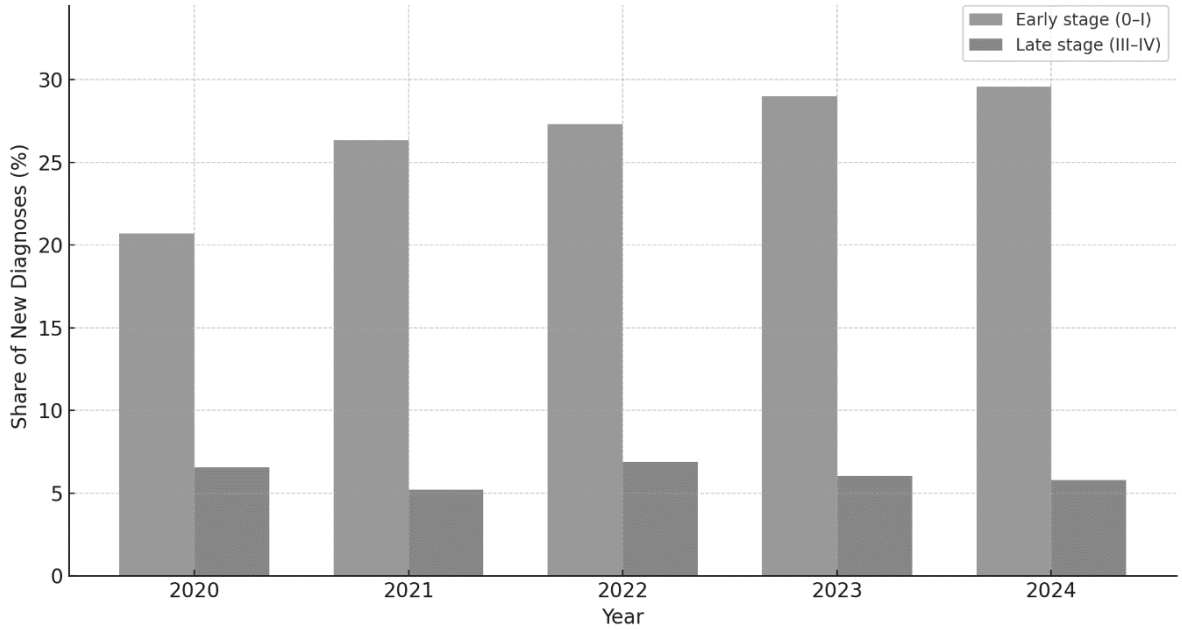

Figure 2. Distribution of early- and late-stage cancer detection in newly diagnosed cases, 2020-2024. Early-stage diagnoses (stage 0-I) steadily increased over the period.

Discussion

The findings of this study indicate a substantial increase in the incidence of malignant neoplasms in the Abay Region during the post-pandemic period (2022-2024), compared to the pre-pandemic and pandemic years. Specifically, the number of newly diagnosed cases rose by 25.6%, and the proportion of early-stage diagnoses increased from 20.7% to 29.6%. At the same time, a steady rise in advanced-stage diagnoses (stage III-IV) and a moderate increase in cancer-related mortality were observed. These data highlight the complex impact of the COVID-19 pandemic on regional oncology services: on one hand, a backlog in demand for diagnostic services likely accumulated; on the other, screening efforts appear to have intensified in the post-pandemic period [6].

Similar patterns were reported in other countries. In the United States, a decline in newly identified cancer cases, an increase in late-stage diagnoses, and a rise in cancer mortality were observed in 2020, primarily due to delayed medical consultations [3,7,8]. In the United Kingdom, diagnostic delays during lockdowns contributed to increased mortality from melanoma and other skin cancers [4]. However, signs of recovery in cancer care systems were reported across most high-income countries by 2022 [5,9].

The Abay Region is one of the areas in Kazakhstan historically affected by environmental radiation exposure due to nuclear weapons testing at the Semipalatinsk Test Site [2]. Although this study does not include dosimetric or tumor-specific data, the historical context of increased medical vulnerability may exacerbate the consequences of diagnostic disruptions and limited access to care during public health emergencies.

The practical significance of this analysis lies in the need to further strengthen systems for early cancer detection, particularly in regions with heightened ecological and epidemiological risks. The findings can inform regional strategies for cancer screening, monitoring, and preparedness of oncology services in future health crises.

The study has several limitations. The analysis covers a relatively short observation period (5 years) and lacks stratification by sex, age, tumor site, or histological type. Additionally, comparisons with other regions of Kazakhstan were not performed, limiting generalizability. No tumor-specific staging (e.g., by localization) was analyzed.

Future research directions should include a longer follow-up period, integration of dosimetric data, stratified analysis by cancer type, and comparative evaluation with other regions of the country.

This study has several limitations. First, it is based on aggregated regional data, which precludes stratification by sex, age, or tumor site. Second, cancer staging was analyzed in broad categories (early vs. late stage) without accounting for specific TNM subgroups or histologies. Third, the time frame covers only five years, limiting long-term trend interpretation. Finally, comparisons with other regions of Kazakhstan or Central Asia were not included, which constrains the generalizability of findings.

Conclusions

This study demonstrated significant changes in cancer-related indicators in the Abay Region during the COVID-19 pandemic. In the post-pandemic period (2022-2024), both the absolute number of newly diagnosed cancer cases and the standardized incidence rate increased. Alongside a moderate rise in cancer-related mortality and the number of advanced-stage diagnoses, a positive trend in early-stage detection was observed, suggesting a partial recovery of oncology services and the reactivation of screening programs.

These findings underscore the importance of systematic preparedness of oncology services to operate during public health emergencies, with an emphasis on maintaining continuity of diagnostics and treatment. Particular attention should be directed toward regions with vulnerable populations and a legacy of environmental exposure, where the consequences of healthcare service disruptions may be more pronounced.

The results of this study may serve as a foundation for the development of regional programs for early cancer detection and monitoring, as well as for assessing the resilience of health systems during future crises.

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Conflicts of Interest. *The authors declare no conflicts of interest.*

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