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TRENDS AND DISPARITIES IN CANCER MORBIDITY IN KAZAKHSTAN: A REGIONAL AND AGE-BASED ANALYSIS FOR 2014-2024

Tolganay N. Ansatbayeva^{1,2}, <https://orcid.org/0000-0002-2540-8147>

Bayan. K. Nurgaliyeva¹, <https://orcid.org/0000-0003-2555-8644>

Oxana P. Tsigengagel³, <https://orcid.org/0000-0002-3170-9712>

Bolat A. Ashirov⁴, <https://orcid.org/0000-0003-0242-9700>

Anvar N. Raziyeu⁵, <https://orcid.org/0009-0008-9819-1031>

¹ Kazakh National Medical University named after S.D. Asfendiyarov, Almaty, Republic of Kazakhstan;

² Almaty Oncology Center, Almaty, Republic of Kazakhstan;

³ Astana Medical University, Astana, Republic of Kazakhstan;

⁴ South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan.;

⁵ Semey Medical University, Semey, Republic of Kazakhstan.

Abstract

Introduction. The overall cancer burden in the Republic of Kazakhstan is increasing. However, existing data may not fully capture the specific trends and disparities among different demographic groups and regions. A detailed understanding of these patterns is critical for effective public health planning and resource allocation.

Aim of the Study: To conduct a comprehensive analysis of cancer morbidity trends in Kazakhstan from 2014 to 2024, identifying key temporal, regional, and age-based disparities, with a particular focus on comparing pediatric and adult populations.

Materials and methods: A retrospective ecological study was conducted using official, aggregated national health statistics. Temporal trends were analyzed by calculating the percentage growth in cases for adults and children (aged 0-17). Regional disparities were assessed using morbidity rates per 100,000 population for the year 2024.

Results: The most striking finding was a disproportionate and rapid increase in pediatric cancer morbidity, which grew by 127.9% over the eleven years, significantly exceeding the 84.7% growth observed in the adult population. Overall, total registered cases increased by 85.2%. The study also confirmed significant geographical inequality, with morbidity rates in the industrial East Kazakhstan Region (2,150.2 per 100,000) being nearly three times higher than in the western Mangystau Region (775.1).

Conclusion: These findings signal the need to reassess national priorities in oncological care. The alarming and out-of-proportion rise in childhood cancer, coupled with persistent regional inequalities, demands an immediate strategic focus on developing pediatric oncology services, including enhanced research into causative factors and strengthening specialized healthcare infrastructure.

Keywords: Cancer, morbidity, epidemiology, Kazakhstan, regional disparity, public health, pediatric oncology.

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Резюме

ТЕНДЕНЦИИ И ДИСПРОПОРЦИИ В ОНКОЛОГИЧЕСКОЙ ЗАБОЛЕВАЕМОСТИ В КАЗАХСТАНЕ: РЕГИОНАЛЬНЫЙ И ВОЗРАСТНОЙ АНАЛИЗ ЗА 2014-2024 ГОДЫ

Толганай Н. Ансатбаева^{1,2}, <https://orcid.org/0000-0002-2540-8147>

Баян К. Нургалиева¹, <https://orcid.org/0000-0003-2555-8644>

Оксана П. Цигенггель³, <https://orcid.org/0000-0002-3170-9712>

Болат А. Аширов⁴, <https://orcid.org/0000-0003-0242-9700>

Анвар Н. Разиев⁵, <https://orcid.org/0009-0008-9819-1031>

¹ НАО «Казахский национальный медицинский университет имени С. Д. Асфендиярова», г. Алматы, Республика Казахстан;

² КГП на ПХВ "Алматинский онкологический центр" УОЗ г. Алматы, Республика Казахстан;

³ НАО «Медицинский университет Астана», г. Астана, Республика Казахстан;

⁴ Южно-Казахстанская медицинская академия, г. Шымкент, Республика Казахстан;

⁵ НАО «Медицинский университет Семей», г. Семей, Республика Казахстан.

Актуальность: В Республике Казахстан отмечается рост общего бремени онкологических заболеваний. Однако существующие данные не в полной мере отражают специфические тенденции и диспропорции внутри различных демографических групп и регионов. Такое детальное понимание необходимо для эффективного планирования и распределения ресурсов в системе здравоохранения.

Цель исследования: Провести комплексный анализ динамики онкологической заболеваемости в Казахстане за период с 2014 по 2024 год, выявив ключевые тенденции, региональные и возрастные диспропорции, с особым акцентом на сравнение педиатрической и взрослой популяций.

Материал и методы: Проведено ретроспективное экологическое исследование на основе официальных агрегированных данных национальной медицинской статистики. Временные тенденции анализировались путем расчета процентного роста случаев для взрослых и детей (0-17 лет). Региональные различия оценивались по интенсивным показателям заболеваемости на 100 000 населения за 2024 год.

Результаты: Наиболее значимым результатом стал непропорционально быстрый рост заболеваемости раком у детей, которая за одиннадцатилетний период увеличилась на 127,9%, что значительно превышает рост в 84,7%, наблюдаемый среди взрослого населения. В целом, общее число зарегистрированных случаев выросло на 85,2%. Исследование также подтвердило значительное географическое неравенство: интенсивные показатели в промышленной Восточно-Казахстанской области (2150,2 на 100 000) почти в три раза превышали показатели в западной Мангистауской области (775,1).

Заключение: Полученные данные служат сигналом о необходимости пересмотра национальных приоритетов в области онкологической помощи. Тревожный и опережающий рост заболеваемости раком у детей, наряду с сохраняющимся региональным неравенством, требует незамедлительного стратегического фокуса на развитии педиатрической онкологической службы, включая углубленное изучение причинных факторов и укрепление специализированной медицинской инфраструктуры.

Ключевые слова: рак, заболеваемость, эпидемиология; Казахстан, региональное неравенство, общественное здравоохранение, детская онкология.

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Түйіндеме

ҚАЗАҚСТАНДАҒЫ ОНКОЛОГИЯЛЫҚ АУРУШАҢДЫҚТАҒЫ ҮРДІСТЕР МЕН ДИСПРОПОРЦИЯЛАР: 2014–2024 ЖЫЛДАР АРАЛЫҒЫНДАҒЫ ӨҢІРЛІК ЖӘНЕ ЖАС ЕРЕКШЕЛІКТЕРІНЕ ТАЛДАУ

Толғанай Н. Ансамбаева^{1,2}, <https://orcid.org/0000-0002-2540-8147>

Баян К. Нурғалиева¹, <https://orcid.org/0000-0003-2555-8644>

Оксана П. Цигенгагель³, <https://orcid.org/0000-0002-3170-9712>

Болат А. Аширов⁴, <https://orcid.org/0000-0003-0242-9700>

Анвар Н. Разиев⁵, <https://orcid.org/0009-0008-9819-1031>

¹ «С.Д. Асфендияров атындағы Қазақ ұлттық медицина университеті» КЕАҚ, Алматы қ., Қазақстан Республикасы;

² Алматы қаласының Қоғамдық денсаулық сақтау басқармасы «Алматы онкология орталығы» ШЖҚ КМК, Алматы қ., Қазақстан Республикасы;

³ «Астана медицина университеті» КЕАҚ; Астана қ., Қазақстан Республикасы;

⁴ Оңтүстік Қазақстан медицина академиясы, Шымкент қ., Қазақстан Республикасы;

⁵ «Семей медицина университеті» КЕАҚ; Семей қ., Қазақстан Республикасы.

Кіріспе: Қазақстан Республикасында онкологиялық аурулардың жалпы жүктемесінің артуы байқалады. Алайда қолда бар деректер әртүрлі демографиялық топтар мен өңірлер арасындағы нақты үрдістер мен диспропорцияларды толық көрсете алмайды. Мұндай жан-жақты түсінік денсаулық сақтау жүйесінде ресурстарды тиімді жоспарлау мен бөлу үшін қажет.

Мақсаты: 2014–2024 жылдар аралығында Қазақстандағы онкологиялық аурушаңдықтың серпінін кешенді түрде талдау, негізгі үрдістерді, өңірлік және жас ерекшеліктеріне байланысты айырмашылықтарды анықтау, әсіресе педиатриялық және ересек популяциялар арасындағы салыстыруға баса назар аудару.

Материалдар және әдістер: Зерттеу ресми ұлттық медициналық статистиканың жинақталған деректері негізінде ретроспективті экологиялық зерттеу ретінде жүргізілді. Уақытша үрдістер ересектер мен балалар (0–17 жас) арасындағы жағдайлардың пайыздық өсуін есептеу арқылы бағаланды. Өңірлік айырмашылықтар 2024 жылға арналған 100 000 халыққа шаққандағы аурушаңдықтың қарқынды көрсеткіштері бойынша есептелді.

Нәтижелері: Ең маңызды нәтиже – балалар арасындағы қатерлі ісік ауруларының шектен тыс қарқынды өсуі болды: он бір жыл ішінде көрсеткіш 127,9%-ға артқан, бұл ересектер арасында байқалған 84,7%-дық өсімнен

әлдеқайда жоғары. Жалпы тіркелген жағдайлар саны 85,2%-ға көбейген. Сондай-ақ, зерттеу айтарлықтай географиялық теңсіздікті растады: өнеркәсіптік Шығыс Қазақстан облысындағы қарқынды көрсеткіш (100 000 адамға 2150,2) батыстағы Маңғыстау облысымен (775,1) салыстырғанда шамамен үш есе жоғары.

Қорытындылар: Алынған деректер онкологиялық көмекті ұйымдастыруда ұлттық басымдықтарды қайта қарау қажеттігін көрсетеді. Балалар арасындағы қатерлі ісікке шалдығудың алаңдатарлық әрі жедел өсуі және өңірлік теңсіздіктің сақталуы педиатриялық онкологиялық қызметті дамытуға стратегиялық назар аударуды талап етеді. Бұл – себептік факторларды терең зерттеу мен мамандандырылған медициналық инфрақұрылымды күшейтуді қамтиды.

Түйінді сөздер: қатерлі ісік, аурушаңдық, эпидемиология, Қазақстан, өңірлік теңсіздік, қоғамдық денсаулық сақтау, балалар онкологиясы.

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Introduction

Cancer represents a significant and growing public health challenge in the Republic of Kazakhstan, mirroring global trends where oncological diseases are a leading cause of mortality [12]. According to the Global Cancer Observatory (GLOBOCAN), in 2022 alone, there were 36,225 new registered cancer cases and 20,686 cancer-related deaths in Kazakhstan, with a 5-year prevalence of 102,845 cases (IARC, 2024). The most common malignancies are breast cancer, lung cancer, and colorectal cancer, collectively constituting over a third of the new cancer burden [8].

The government of Kazakhstan has implemented national strategies aimed at combating this burden, including national screening programs for breast, cervical, and colorectal cancers [10]. These efforts have yielded some success; studies indicate a decline in mortality for certain cancers and an increase in early-stage detection, likely linked to screening initiatives [6].

However, significant challenges remain. Kazakhstan is a vast country with considerable demographic and socio-economic diversity, leading to marked regional disparities in cancer incidence and mortality [9]. Previous research has consistently identified higher cancer rates in the northern and eastern industrial regions compared to the southern and western parts of the country [3]. These disparities highlight the need for targeted interventions. Furthermore, understanding the distinct morbidity patterns between the adult and pediatric populations, as well as the quality of life and satisfaction of patients undergoing treatment, is critical for a holistic assessment of the cancer care system [2].

This study **aims** to fill this gap by providing a comprehensive analysis of cancer morbidity trends in Kazakhstan from 2014 to 2024. By disaggregating national data by region and age group (adults vs. children), this research seeks to identify high-risk populations, evaluate the extent of regional and age-related disparities, and provide an evidence base for tailoring future public health strategies.

Materials and methods

Study Design and Data Source

A retrospective ecological study was conducted using official aggregated national health statistics. The primary data on cancer morbidity (newly registered cases) for the period 2014–2024 were obtained from the National Cancer Registry, which is managed by the Kazakh Institute of

Oncology and Radiology (KazIOR). Data for the years 2022–2024 were based on projections derived from the preceding years' trends. Population data for calculating rates were obtained from the official releases of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

Study Variables

The primary variables for this study were: (I) region (including the newly formed Abai, Zhetysay, and Ulytau regions); (II) year of registration (2014–2024); (III) number of adult cancer cases; and (IV) number of pediatric cancer cases (defined as age 0–17 years).

Statistical analysis

Descriptive statistics were used to summarize the number of cases and trends over time. Crude morbidity rates per 100,000 population were calculated for each region and year to facilitate comparisons. The overall change in morbidity from 2014 to 2024 was quantified as a percentage change. All data were managed and analyzed using SPSS version 27.0 for Windows (IBM Corp., Armonk, NY, USA).

To analyze temporal trends and identify statistically significant changes in morbidity dynamics, a Joinpoint regression analysis was performed. This method identifies points in time (joinpoints) where a significant change in the trend occurs and calculates the Annual Percent Change (APC) for each resulting segment. The analysis was conducted separately for the adult and pediatric cohorts. A logarithmic scale was used on the y-axis for visualization to appropriately compare trends of different magnitudes.

Ethical Statement

This study utilized publicly available, aggregated, and anonymized data. Therefore, formal ethical review board approval was not required.

Results

Overall Nationwide Trend in Cancer Morbidity

Over the eleven years from 2014 to 2024, Kazakhstan experienced a substantial and consistent increase in the total number of registered cancer cases. As detailed in Table 1, the total morbidity grew by 85.2%, from 130,695 cases in 2014 to a projected 242,063 in 2024.

Disproportionate Growth in Pediatric Cancer Morbidity

A key finding of this study is the disproportionate rate of growth in cancer cases among children compared to adults. While adult morbidity increased by a significant 84.7%, the corresponding growth in the pediatric population (aged 0–

17) was substantially higher at 127.9% over the same period (Table 1).

This divergence in growth trends is clearly illustrated in Figure 1. The indexed growth chart, which sets 2014 as a 100% baseline, shows the pediatric morbidity curve

rising much more steeply than the adult curve. Annotations on the chart indicate that the peak year-over-year growth for children occurred in 2017 (+19.5%), five years earlier than the peak for adults in 2022 (+19.5%).

Table 1.

Overall Trend in Cancer Morbidity in the Republic of Kazakhstan (2014-2024).

Indicator	2014	2016	2018	2020	2022	2024 (projected)	Growth (2014-2024)
Number of adults	129,088	148,881	166,413	179,355	210,262	238,400	+84.7%
Number of children (aged 0-17)	1,607	1,846	2,176	2,828	3,254	3,663	+127.9%
Total registered cases	130,695	150,727	168,589	182,183	213,516	242,063	+85.2%

(Note: For clarity, only even years are displayed, but the growth calculation is based on the full 2014-2024 period.)

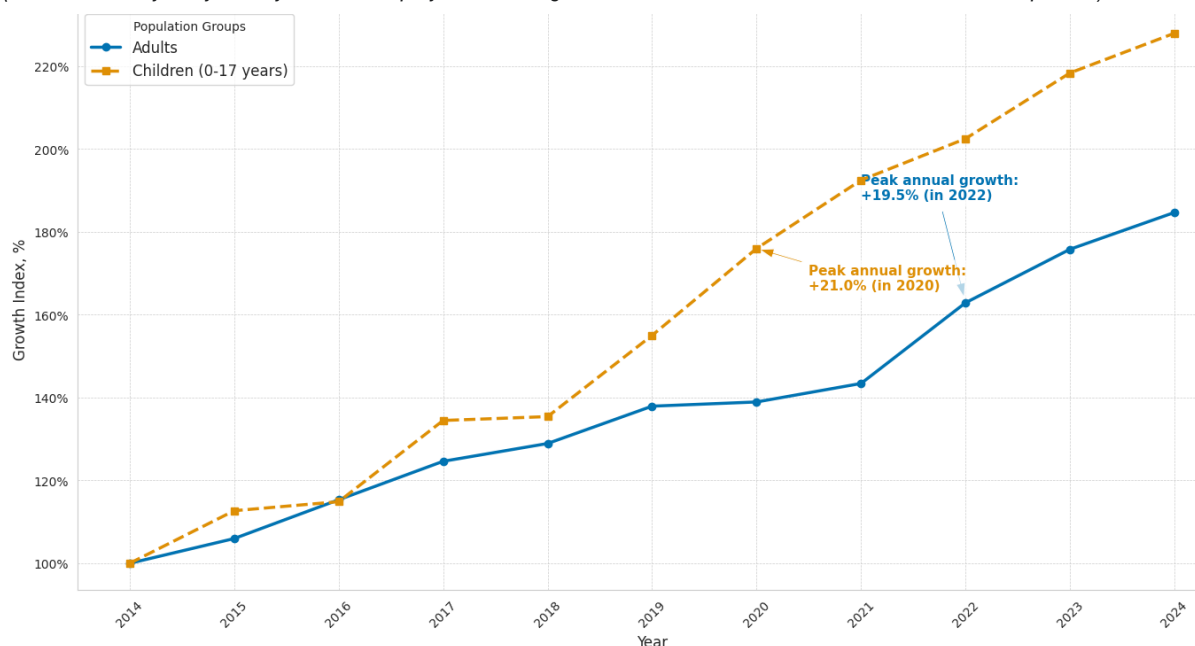


Figure 1. Indexed Growth of Cancer Morbidity by Age Group in Kazakhstan (2014–2024).

Regional Disparities in Cancer Burden.

The national cancer burden is not distributed evenly across the country. Table 2 highlights significant regional disparities in the morbidity rate per 100,000 population for the projected year 2024. The highest rates are concentrated in industrial regions, including East Kazakhstan Region

(2150.2), Pavlodar Region (1997.1), and Karaganda Region (1965.3). In contrast, the lowest morbidity rates are observed in Mangystau (775.1), Kyzylorda (838.3), and Atyrau (853.9) regions. The morbidity rate in the highest-burden region is nearly three times that of the lowest, underscoring the profound geographical inequality

Table 2.

Regional Disparities in Cancer Morbidity (2024, projected).

Region	Total Cases (2024, projected)	Population	Morbidity Rate per 100,000
Regions with Highest Case Numbers			
Almaty City	34,256	2,228,677	1537.0
Karaganda Region	22,314	1,135,351	1965.3
Astana City	17,329	1,430,117	1211.7
East Kazakhstan Region	15,633	727,053	2150.2
Pavlodar Region	15,057	753,933	1997.1
Regions with Lowest Case Numbers			
Kyzylorda Region	7,058	841,929	838.3
Zhetysu Region	7,238	697,987	1037.0
Mangystau Region	6,099	786,837	775.1
Atyrau Region	6,012	704,074	853.9
Ulytau Region	2,442	221,582	1102.0

The results of the Joinpoint regression analysis are presented in Figure 2. The analysis identified statistically significant joinpoints for both groups around the year 2021. For the adult cohort, a joinpoint was detected at 2021.0, indicating a change in the Annual Percent Change (APC)

from that point forward. For the pediatric cohort, a similar joinpoint was identified at 2021.5. Despite this change in the rate of increase, the overall trend for both groups remained positive throughout the entire study period, confirming a sustained growth in morbidity.

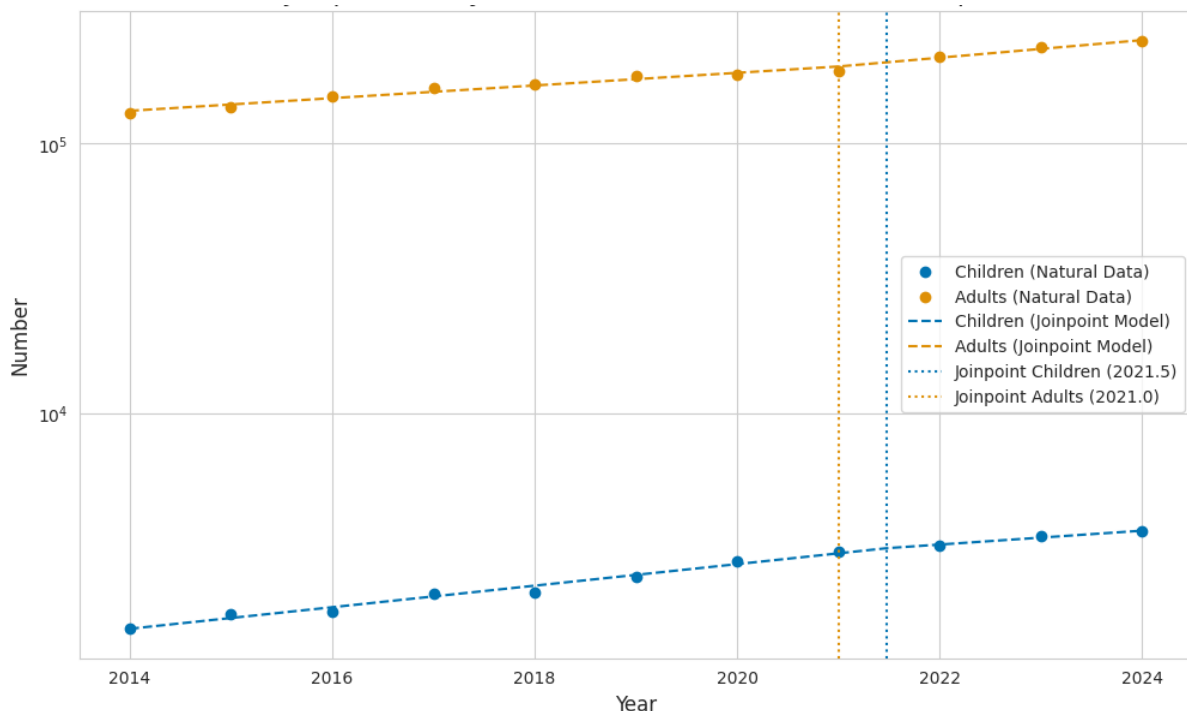


Figure 2. Joinpoint Regression Analysis of Cancer Morbidity Trends in Kazakhstan (2014-2024).

Discussion

To the best of our knowledge, this study provides one of the first comprehensive analyses of cancer morbidity trends in Kazakhstan from 2014 to 2024, with a specific focus on regional and age-based disaggregation. Our primary findings are a steady increase in overall cases, pronounced regional disparities, and a concerning rise in pediatric cancer, aligning with and building upon the existing body of literature, revealing deeper systemic challenges within the nation's healthcare system.

The significant regional disparities identified, with the highest morbidity burden concentrated in the northern and eastern industrial regions (East Kazakhstan, Karaganda, Pavlodar), are consistent with previous studies on specific cancers such as lung, kidney, and prostate cancer in Kazakhstan [3]. This enduring geographical pattern is likely multifactorial. It may be attributable to a combination of historical environmental pollution from heavy industry and the legacy of the former Semipalatinsk nuclear test site, which has been linked to increased thyroid cancer incidence in the area [4]. Furthermore, socio-economic factors and potential urban-rural divides in screening access and awareness likely contribute to these disparities [11].

A key finding of our study is the detection of joinpoints around 2021 for both the adult and pediatric cohorts. This synchronicity is likely a statistical echo of the COVID-19 pandemic. We hypothesize that disruptions to healthcare access and reduced screening activities during 2020-2021 led to a temporary slowdown in diagnoses (a "diagnostic gap"). This was likely followed by a "catch-up" period,

resulting in a compensatory rise in registered cases in subsequent years. Our analysis suggests that the healthcare system began to identify these deferred cases after 2021, leading to the statistically significant change in the morbidity trend. This finding highlights the vulnerability of oncological services to systemic shocks and underscores the importance of maintaining diagnostic continuity, even during a crisis.

The growth in overall registered cancer cases, while seemingly negative, may paradoxically reflect positive developments [5,7]. The implementation and expansion of national screening programs for breast, cervical, and colorectal cancers have demonstrably increased detection rates, particularly for early-stage disease [10]. However, the fact that a significant proportion of cancers are still diagnosed at later stages suggests that barriers to timely medical consultation persist [1].

Beyond incidence and mortality rates, the quality of care and patient experience are critical metrics for evaluating the healthcare system. A study by Atabayeva A. [2] revealed that nearly half of blood cancer patients in Semey, a high-morbidity region, were dissatisfied with their clinical management. This finding suggests that even when treatment is available, its organization and accessibility may be suboptimal. This patient dissatisfaction could be linked to broader systemic issues, such as the documented regional disparity in drug provision, where access to modern targeted therapies is often contingent on the economic status of the region [11].

Perhaps the most alarming finding of our study is the sharp proportional increase in pediatric cancer cases. While

the absolute numbers remain small compared to the adult population, the steep upward trend is a serious signal that warrants urgent attention. This rise could be partly due to improved diagnostics and more complete registration, but it also raises critical questions about the potential role of environmental, lifestyle, or genetic risk factors that require dedicated, targeted investigation.

Limitations

This study has several limitations. Firstly, as a retrospective ecological study, it cannot establish causality at an individual level. Secondly, its reliance on aggregated registry data may be subject to variations in reporting quality and completeness across regions. Finally, data for 2022–2024 are projections and should be interpreted with caution.

Conclusion

The burden of cancer in Kazakhstan continues to grow, characterized by significant and widening disparities between regions and age groups. Our findings underscore the urgent need for a multi-faceted and data-driven national response. Policy must evolve from a uniform, one-size-fits-all approach to targeted interventions focused on the high-morbidity northern and eastern regions, addressing both environmental risk factors and barriers to screening and care. Furthermore, efforts must extend beyond mere detection to enhancing the entire patient journey. This includes improving the quality of care delivery, addressing patient satisfaction, and ensuring equitable access to modern diagnostics and treatments across all regions of the country. Most critically, the alarming rise in pediatric cancer must be recognized as a national priority. This demands immediate strategic action to bolster research into causative factors, improve early detection protocols for children, and build a robust, specialized pediatric oncology infrastructure to provide the best possible care for the youngest and most vulnerable patients in Kazakhstan.

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Author Information

Tolganay N. Ansatbayeva - Oncologist of a Mobile Palliative Home Care Team, Municipal Oncology Center, Almaty, Kazakhstan; 220 Papanina St., Building A. Non-Profit JSC "Kazakh National Medical University named after S.D. Asfendiyarov; 94 Tole Bi Street, tol72umit@mail.ru, <https://orcid.org/0000-0002-2540-8147>, +7 776 002 9939

Bayan. K. Nurgaliyeva - Head of the Department of Propaedeutic of Internal Diseases, Non-Profit Joint Stock Company "Kazakh National Medical University named after S.D. Asfendiyarova; 94 Tole Bi Street, nurgaliyeva.b@kaznmu.kz, <https://orcid.org/0000-0003-2555-8644>, +7 701 210 6281

Bolat A. Ashirov - Candidate of Medical Sciences, South Kazakhstan Medical Academy, Republic of Kazakhstan, <https://orcid.org/0000-0003-0242-9700>, e-mail: bolat.baja@mail.

Anvar N. Razyev - PhD doctoral student in Public Health, Semey Medical University, Semey, Republic of Kazakhstan. General Bespayev Street 10, apartment 12, anvar.razyev@smu.edu.kz, 8-701-532-81-28

Corresponding author:

Oxana Tsigengagel – Head of the Department of Biostatistics, Bioinformatics, and Information Technology, Astana Medical University, Astana, Republic of Kazakhstan;

Address: (010000) Kazakhstan, Astana city, Beybitshilik street 49a

E-mail: tsigengagel.o@gmail.com

Phone: +7 7476218603