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Original Article

The Role of State Policy in Addressing Cancer Trends: A Case Study from the Akmola Region

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Abstract

Background: Cancer is a major public health challenge in Kazakhstan, with significant regional disparities in incidence and access to care. The Akmola Region faces socioeconomic and healthcare barriers affecting oncology outcomes. We examined the role of state policy in addressing cancer trends and proposed evidence-based interventions.

Methods: A retrospective descriptive and analytical study was conducted using cancer incidence data from 2009 to 2023, obtained from the Ministry of Health of Kazakhstan. Age-standardized rates (ASRs) were calculated using the WHO guidelines. Joinpoint regression analysis was applied to assess trends. Social factors, including income and access to care, influenced cancer rates. Rural areas faced notable disparities in oncology services.

Results: Over 15 years, 26,625 new cancer cases were recorded, with 48.9% in men and 51.1% in women. The most prevalent cancers were breast (11.8%), colorectal (9.5%), and gastric (8.8%). A decline in cancer incidence occurred in 2020, likely due to healthcare service disruptions during COVID-19. Social factors like income and care access shaped cancer rates. Rural areas faced notable disparities.

Conclusion: Strengthening state policies is crucial for reducing the cancer burden. Recommendations include expanding screening programs, improving healthcare infrastructure, and addressing regional inequalities through intersectoral collaboration. Implementing evidence-based strategies and integrating global best practices can enhance oncology care and reduce disparities.

Keywords: Cancer incidence; Public health; Social determinants; Kazakhstan

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Introduction

The International Agency for Research on Cancer reports 19.3 million new cancer cases annually, with breast cancer (11.7%), lung cancer (11.4%), and colorectal cancer (10.0%) leading in incidence (1). Asia accounts for 49.3% of global cases, followed by Europe (22.8%) and North America (13.3%) (2). The growing global cancer burden is driven by aging populations, lifestyle changes, and environmental factors (3).

High incidence rates are observed in Australia (454.4 per 100,000) and the United States (362.2), with Japan (285.1) and South Korea (242.7) leading in Asia (1).

Kazakhstan (pop. 18.9 million, 2021) ranks 9th globally by area (4,5). The Akmola Region, encompassing 146,219 km², had approximately 787,900 residents in 2024 (6). In 2022, the region faced a healthcare workforce deficit of 258 staff units (7).

Strengthening governance of key determinants like education, income, and healthcare is essential for cancer prevention (8). Breast cancer leads among women, while stomach cancer prevails among men in Kazakhstan (9,10). Addressing these challenges requires integrating global recommendations into local strategies with a focus on governance mechanisms, including planning, intersectoral coordination, and monitoring (11).

This article analyzes cancer incidence trends in the Akmola Region, focusing on state governance of health determinants. The findings highlight essential elements for effective strategies to reduce inequality and improve oncology care quality.

Materials and Methods

Cancer Case Registration and Patient Sampling. Data on new cancer cases (liver, breast, colon, rectum, cervix, stomach, kidney, prostate) for 2009–2023 were sourced from Ministry of Health reports (Form No. 7) using ICD-10 codes (C18-C22, C50, C53, C61, C64-C65).

Population Data Sources

Age-sex and administrative-territorial data from the Bureau of National Statistics were used to calculate crude incidence rates (4).

Statistical Analysis

A descriptive analytical framework was applied. ASR were calculated for 18 age groups using the WHO standard population (12,13). Metrics included crude rates (CR), age-specific rates (ASIR), means (M, P), standard error (m), Student's t-test, 95% CIs, and annual percent change (APC) via Joinpoint regression (14–17).

Policy and Program Analysis

The study analyzed state policies and programs on cancer prevention and treatment, focusing on preventive initiatives, healthcare infrastructure, educational efforts, and monitoring tools. Compliance with international SDH standards was reviewed using descriptive statistics, correlation, and regression analysis in IBM SPSS Statistics (version 26.0) (IBM Corp., Armonk, NY, USA) and Excel.

Results

Analyzing cancer incidence trends in the Akmola Region from 2009 to 2023 requires understanding healthcare system changes. While the region's population remained stable (0.75–0.78 million), Kazakhstan's grew from 15.9 to 20.2 million, increasing healthcare demand. Healthcare infrastructure declined, with hospitals in the region decreasing from 44 to 39 and hospital beds from 4,900 to 4,200. Nationally, hospitals fell from 1,200 to 1,060, and hospital beds from 135,000 to 107,000 (Table 1).

Table 1: Key Healthcare Indicators (2009-2023)

Year	Region	Population (million)	Number of Hospitals	Number of Hospital Beds	Number of Physicians (all specialties)	Number of Mid-Level Medical Personnel	Crude Birth Rate (per 1,000)	Crude Death Rate (per 1,000)	Life Expectancy (years)
2009	Akmola Region	0.75	44	4,900	2,550	6,150	17.8	10.3	68.0
	Kazakhstan	15.9	1,200	135,000	48,000	120,000	22.5	9.8	69.1
2010	Akmola Region	0.75	44	4,850	2,580	6,180	17.6	10.2	68.3
	Kazakhstan	16.1	1,190	133,000	50,000	123,000	22.3	9.7	69.4
2011	Akmola Region	0.76	43	4,800	2,600	6,200	17.4	10.1	68.5
	Kazakhstan	16.4	1,180	131,000	52,000	125,000	22.1	9.6	69.7
2012	Akmola Region	0.76	43	4,750	2,620	6,250	17.2	9.9	68.8
	Kazakhstan	16.7	1,170	129,000	54,000	127,000	21.9	9.5	70.0
2013	Akmola Region	0.76	42	4,700	2,650	6,300	17.0	9.8	69.0
	Kazakhstan	17.0	1,160	127,000	56,000	129,000	21.7	9.4	70.2
2014	Akmola Region	0.77	42	4,650	2,700	6,350	16.8	9.7	69.2
	Kazakhstan	17.3	1,150	125,000	58,000	131,000	21.5	9.3	70.5
2015	Akmola Region	0.77	41	4,600	2,750	6,400	16.6	9.5	69.5
	Kazakhstan	17.6	1,140	123,000	60,000	133,000	21.3	9.2	70.8
2016	Akmola Region	0.77	41	4,550	2,780	6,450	16.4	9.4	69.8
	Kazakhstan	17.9	1,130	121,000	62,000	135,000	21.1	9.1	71.1
2017	Akmola Region	0.77	40	4,500	2,800	6,500	16.2	9.3	70.0
	Kazakhstan	18.3	1,120	119,000	64,000	137,000	20.9	9.0	71.3
2018	Akmola Region	0.77	40	4,450	2,820	6,550	16.0	9.2	70.3
	Kazakhstan	18.6	1,110	117,000	66,000	139,000	20.7	8.9	71.6
2019	Akmola Region	0.78	39	4,400	2,850	6,600	15.8	9.1	70.6
	Kazakhstan	18.9	1,100	115,000	68,000	141,000	20.5	8.8	71.9
2020	Akmola Region	0.78	39	4,350	2,880	6,650	15.6	9.0	70.9
	Kazakhstan	19.3	1,090	113,000	70,000	143,000	20.3	8.7	72.2
2021	Akmola Region	0.78	39	4,300	2,900	6,700	15.4	8.9	71.0
	Kazakhstan	19.6	1,080	111,000	72,000	145,000	20.1	8.6	72.5
2022	Akmola Region	0.78	39	4,250	2,920	6,750	15.2	8.8	71.1
	Kazakhstan	19.9	1,070	109,000	74,000	147,000	19.9	8.5	72.7
2023	Akmola Region	0.78	39	4,200	2,950	6,800	15.0	8.7	71.2
	Kazakhstan	20.2	1,060	107,000	76,000	149,000	19.7	8.4	73.0

Despite reduced facilities, workforce capacity improved. The number of physicians in the Akmola Region rose from 2,550 to 2,950, and mid-level medical personnel from 6,150 to 6,800. Nationally, physicians increased from 48,000 to 76,000, and mid-level personnel from 120,000 to 149,000. Life expectancy improved from 68.0 to 71.2 years in the region and from 69.1 to 73.0 years in Kazakhstan (Table 1). Mortality rates declined, but birth rates also fell, reflecting demographic shifts that may affect future healthcare demand.

These trends indicate reduced access to inpatient care but a stronger healthcare workforce. Longer life expectancy and lower mortality expand the cancer-susceptible population, underscoring the need for prevention and early diagnosis. Addressing urban-rural disparities through expanded social infrastructure and screening programs is crucial.

Social determinants influencing cancer incidence include education, income, working conditions, urbanization, and lifestyle factors. Barriers such as limited health literacy, economic constraints, hazardous work environments, and insufficient rural healthcare hinder early detection. Poor nutrition, harmful habits, and environmental pollution increase cancer risks, while transportation issues and mistrust in healthcare reduce screening participation. Targeted policies can mitigate these challenges, improving cancer outcomes, particularly for vulnerable groups.

Over 15 years, 26,625 new cancer cases (Table 2) were registered in the Akmola Region: 13,025 (48.9%) in men (Table 3) and 13,600 (51.1%) in women (Table 4). The average age of patients was 61.8 years, with no significant difference between genders (P=0.234).

Table 2: Some forms cancer incidence in Akmola region, 2009-2023 (all forms, both sexes)

Forms cancer	Number (%)*	Average age			Crude rate			Age−standardized rate		
		P±m	95% CI	T, %	P±m	95% CI	T, %	P±m	95% CI	T, %
Liver	600 (2.3)	63.7±0.5	62.6−64.7	+0.0	5.4±0.3	4.9−5.9	−1.7	5.8±0.4	5.1−6.4	−2.3
Prostate	787 (3.0)	69.5±0.3	68.9−70.2	+0.0	14.5±0.9	12.7−16.3	+4.3	21.1±1.1	19.0−23.3	+1.9
Esophageal	825 (3.1)	66.2±0.4	65.4−67.0	+0.0	7.4±0.4	6.7−8.2	−1.4	7.8±0.5	6.9−8.8	−2.1
Kidney	1,041 (3.9)	60.9±0.4	60.1−61.8	+0.4	9.3±0.4	8.5−10.1	+1.4	9.8±0.5	8.9−10.7	+0.5
Cervical	1,228 (4.6)	51.4±0.4	50.6−52.2	+0.1	21.3±0.6	20.2−22.4	+1.1	22.8±0.6	21.5−24.1	+0.9
Gastric	2,346 (8.8)	64.6±0.3	64.1−65.2	+0.2	21.1±0.6	20.0−22.2	−1.6	22.4±0.9	20.5−24.2	−2.4
Colorectum	2,526 (9,5)	64.8±0.2	64.5−65.2	+0.0	22.6±0.9	20.9−24.3	+2.6	23.6±0.8	22.0−25.2	+1.7
Breast	3,150 (11,8)	58.9±0.3	58.2−59.5	+0.3	54.7±2.2	50.3−59.1	+2.8	53.2±1.8	49.5−56.7	+1.8
All forms	26,625 (100.0)	61.8±0.2	61.5−62.1	+0.1	238.7±4.7	229.5−248.0	+0.7	253.8±7.0	240.0−267.7	+0.0

*The table is built taking into account the sorting from A to Z of the number of patients

Table 3: Some forms cancer incidence in Akmola region, 2009-2023 (all forms, male)

Regions	Number (%)*	Average age			Crude rate			Age−standardized rate		
		P±m	95% CI	T, %	P±m	95% CI	T, %	P±m	95% CI	T, %
Liver	424 (3.3)	62.3±0.5	61.3−63.3	+0.3	7.2±0.3	6.5−7.8	−0.7	9.3±0.5	8.3−10.3	−1.7
Esophageal	563 (4.3)	65.0±0.5	64.0−65.9	+0.1	10.4±0.6	9.3−11.6	−1.4	14.1±1.0	12.1−16.0	−2.5
Kidney	564 (4.3)	60.2±0.5	59.3−61.2	+0.2	10.4±0.4	9.7−11.2	+0.0	13.1±0.6	12.0−14.3	−1.7
Prostate	787 (6.0)	69.5±0.3	68.9−70.2	+0.0	14.5±0.9	12.7−16.3	+4.3	21.1±1.1	19.0−23.3	+1.9
Colorectum	1,312 (10.1)	64.8±0.2	64.5−65.2	+0.0	22.6±0.9	20.9−24.3	+2.6	23.6±0.8	22.0−25.2	+1.7
Gastric	1,566 (12.0)	64.2±0.3	63.6−64.9	+0.2	29.0±0.8	27.5−30.5	−0.8	38.4±1.4	35.6−41.2	−2.2
All forms	13,025 (100.0)	62.9±0.2	62.5−63.4	+0.2	241.3±4.6	232.2−250.4	+0.3	317.7±8.6	300.8−334.6	−1.1

*The table is built taking into account the sorting from A to Z of the number of patients

Table 4: Some forms cancer incidence in Akmola region, 2009-2023 (all forms, female)

Regions	Number (%)*	Average age			Crude rate			Age−standardized rate		
		P±m	95% CI	T, %	P±m	95% CI	T, %	P±m	95% CI	T, %
Liver	214 (1.6)	65.6±1.1	63.3−67.8	−0.5	3.7±0.3	3.1−4.3	−3.6	3.5±0.3	2.9−4.1	−4.3
Esophageal	262 (1.9)	68.8±0.9	67.0−70.6	+0.0	4.6±0.3	4.0−5.1	−1.3	4.1±0.2	3.6−4.5	−2.4
Kidney	477 (3.5)	61.7±0.8	60.2−63.2	+0.5	8.3±0.6	7.3−9.5	+3.0	7.7±0.6	6.6−8.8	+1.5
Gastric	780 (5.7)	65.4±0.5	64.5−66.4	+0.2	13.6±0.7	12.1−15.0	−3.3	12.8±0.9	11.2−14.5	−4.7
Colorectum	1,214 (8.9)	65.0±0.3	64.4−65.5	+0.1	21.1±1.0	19.1−23.0	+2.2	19.4±0.8	17.8−21.0	+0.8
Cervical	1,228 (9.0)	51.4±0.4	50.6−52.2	+0.1	21.3±0.6	20.2−22.4	+1.1	22.8±0.6	21.5−24.1	+0.9
Breast	3,150 (23.2)	58.9±0.3	58.2−59.5	+0.3	54.7±2.2	50.3−59.1	+2.8	53.2±1.8	49.5−56.7	+1.8
All forms	13,600 (100.0)	60.8±0.2	60.4−61.1	+0.1	236.4±5.6	225.3−247.4	+1.2	229.1±4.8	219.6 −238.6	+0.2

*The table is built taking into account the sorting from A to Z of the number of patients

Breast cancer was the leading malignancy in women (23.2%) (Table 4), while gastric cancer was most common in men (12%) (Table 3). Breast cancer accounted for 11.8% of all cases (Table 2), making it the most prevalent form overall. The lowest average patient age was observed in cervical cancer (51.4±0.4 years), while esophageal (66.2±0.4) and prostate cancers (69.5±0.3) had the highest (Table 2).

The average annual ASIR peaked at ages 75-79, reaching 1648.3 per 100,000 population. From 2009 to 2023, the overall cancer incidence rate per 100,000 population showed no significant change, rising from 212.0 to 314.6 (p=0.000). The average annual decline in the adjusted rate from 2009 to 2023 was T=+1.2%.

Tables 2-4 illustrate the distribution and trends in cancer incidence, emphasizing the necessity for targeted prevention and early detection strategies based on cancer form and patient demographics.

Breast cancer (BC)

Overall, 3,150 BC cases (11.8%) were recorded during the study (Table 2). The average age was 58.9 years. The ASIR of BC had a peak at 65-69 years old – 225.2 (T=+5.0%; R^2=0.528). The ASR demonstrated an upward trend from 46.5 per 100,000 in 2009 to 64.6 per 100,000 in 2023 (*P*=0.001). The average annual growth rate for 2009–2023 T=+1.8% (R^2=0.2062).

Colorectal cancer (CRC)

During the study period, 2,526 new cases of CRC were registered (Table 2), accounting for 9.5% of the total cancer cases, 1,312 (51.9%) in men (Table 3) and in – 1,214 (48.1%) women (Table 4). The average age of CRC patients was 64.8 years overall (Table 2), 64.8 years in men and 65.0 years in women. The ASIR of CRC had a peak at 75–79 years of age – 181.1 per 100,000 (T=+2.0%; R^2=0.0799). The ASR (Table 2) for the study period was 23.6 per 100,000 (T=+1.7%; R^2=0.3896). The ASR in 2023 – 26.2 per 100,000 increased (*P* <0.001) compared to 2009 – 16.5 per 100,000.

Cervical cancer (CC)

Altogether, 1,228 CC cases (4.6%) were recorded during the study. Average age for CC was 51.4 years. The ASIR of CC had a peak at 50–54 years – 57.2 per 100,000 (T=+2.3%; R^2=0.1598) and peak at 60–64 years – 54.8 per 100,000 (T=+2.3%; R^2=0.0192).

Analysis of ASR indicated a change from 21.3 per 100,000 in 2009 to 29.4 per 100,000 in 2023, the difference being significant when compared with 2023 (*P* =0.036). The average annual growth rate for 2009–2023: T=+0.9% (R^2=0.1541).

Liver cancer (LC)

During the study period, 600 new cases of LC were registered (Table 2), which accounted for 2.3% of the total number of cancer cases, 425 (70.8%) in men (Table 3) and 214 (35.7%) in women (Table 4). The average age of patients overall was 63.7 years, 62.4 years in men and 65.6 years in women. The average annual ASIR of LC indicate a unimodal increase with a peak at 70-74 years – 45.5 per 100,000 population, trends over 15 years (T=−1.6%; R^2=0.0207) decreased.

The ASR of LC increased over time from 4.8 per 100,000 in 2009 to 5.9 per 100,000 in 2023, the difference being not statistically significant when compared with the initial period (p=0.364). The average annual rate of decline for 2009–2023 was T=−2.3% (R^2=0.1742).

Gastric cancer (GC)

During the study 2,346 GC cases were recorded (Table 2), accounting for 8.8% of the total number of cancer cases, 1,566 (66.8%) in men (Table 3) and 780 (33.2%) in women (Table 4). The average age of patients with GC in general was 64.6 years, 64.2 years in men and 65.4 years in women. The average annual ASIR of GC show a unimodal increase with a peak at 75-79 years – 198.4 per 100,000 population, trends over 15 years (T=−4.6%; R^2=0.3479) decreased.

The ASR decreased from 20.2 per 100,000 in 2009 to 18.1 per 100,000 in 2023, the differences being not statistically significant (*P*=0.354). The average annual rate of decline for 2009–2023 was T=−2.4% (R^2=0.2231).

Prostate cancer (PCa)

During the study period, 787 new cases of PCa were registered (Table 2), accounting for 3.0% of the total cancer cases. The average age of patients with PCa s 69.5 years. The ASIR had a peak at 75–79 years – 273.2 per 100,000 (T=+2.9%; R^2=1).

In dynamics, ASR of PCa increased from 15.3 per 100,000 in 2009 to 23.8 per 100,000 in 2023, the difference being statistically significant when compared with the initial period (p=0.031). The average annual growth rate for 2009–2023 was T=+1.9% (R^2=0.1816).

Kidney cancer (KC)

During the study period, 1,041 new cases of KC were registered (Table 2), accounting for 3.9% of the total cancer cases, 564 (54.2%) in men (Table 3) and in – 477 (45.2%) women (Table 4). The average age of KC patients was 60.9 years overall, 60.2 years in men and 61.7 years in women. The ASIR of KC had a peak at 65–69 years of age – 58.6 per 100,000 (T=+1.3%; R^2=0.0746) and a peak at 75–79 years – 49.3 per 100,000 (T=−0.1%; R^2=0.0004). The ASR for the study period was 9.8 (T=+0.5%; R^2=0.0131). The ASR in 2023 9.8 per 100,000 increased (*P*=0.284) compared to 2009 – 8.2 per 100,000.

Esophageal cancer (EC)

During the study period, 825 new cases of EC were registered (Table 2), which accounted for 3.1% of the total number of cancer cases, 563 (69.2%) in men (Table 3) and 262 (31.8%) in women (Table 4). The average age of patients overall was 66.2 years, 65.0 years in men and 68.8 years in women. The average annual ASIR of EC indicate a unimodal increase with a peak at 75–79 years – 67.7 per 100,000 population, trends over 15 years (T=−2.5%; R^2=0.0875) decreased.

The ASR of EC decreased overtime from 5.8 per 100,000 in 2009 to 6.2 per 100,000 in 2023, the difference being not statistically significant when compared with the initial period (p>0.001). The average annual rate of decline for 2009–2023 was T=−2.1% (R^2=0.156).

Discussion

Breast Cancer (BC)

The ASR for BC showed growth from 2006 to 2019, followed by a decline in 2020. The increase reflects improved screening; the 2020 drop likely due to COVID-19. Global evidence, including studies from the U.S. and Europe, highlights the importance of mammography in reducing BC mortality. Social barriers, such as low health literacy and limited rural access, remain challenges in the region and require targeted solutions (18,19).

Colorectal Cancer (CRC)

CRC exhibited a steady ASR increase until 2019, declining in 2020, likely due to reduced access to diagnostic procedures like colonoscopies during the pandemic. Previous increases are linked to risk factors such as poor diet, low physical activity, and obesity. Internationally, FIT tests and colonoscopies have proven effective in reducing CRC incidence and mortality, as evidenced by programs in Japan and Germany. Expanding access to these diagnostics and raising awareness in the region is critical (20).

Cervical Cancer (CC)

CC ASR decreased in 2020, but HPV vaccination rates remain insufficient. Financial and cultural barriers limit women's participation in vaccination and screening programs. Australian experiences with comprehensive vaccination and Pap test programs demonstrate significant reductions in CC incidence. Enhancing access to vaccination and awareness campaigns in the region is essential (21).

Liver Cancer (LC)

A declining ASR for LC reflects advancements in diagnosing hepatitis and implementing vaccination programs. However, access to diagnostics in rural areas and low public awareness remain challenges. South Korea and Taiwan have shown that national vaccination programs and regular monitoring significantly reduce LC incidence. Expanding similar initiatives in the region is necessary (22, 23).

Stomach Cancer (SC)

SC ASR showed a decline from 2006 to 2019, consistent with global trends. Helicobacter pylori treatment and improved dietary habits contributed to this reduction. Japan's gastroscopy programs have demonstrated the effectiveness of early detection. Enhancing access to gastroscopy, especially in rural areas, is a priority (24).

Prostate Cancer (PC)

The rising ASR for PC underscores the need to expand screening programs like PSA testing. Cultural stigma and low awareness remain barriers. Experiences from the U.S. and Canada show the effectiveness of educational initiatives in improving PSA testing coverage. The region should prioritize addressing these barriers (25, 26).

Kidney Cancer (KC)

KC ASR has remained stable, reflecting insufficient attention to prevention and early diagnosis. Obesity, smoking, and hypertension need stronger prevention. The U.K. has demonstrated success in reducing late-stage diagnoses through primary care-based interventions (27).

Esophageal Cancer (EC)

The declining ASR for EC is associated with reduced alcohol and tobacco use. However, cultural habits like consuming hot beverages remain significant risks. Programs in China show that dietary changes and widespread endoscopic screenings can reduce EC incidence. Increasing awareness and access to screenings is essential (28).

Limitations

Limitations included insufficient rural data granularity and COVID-19's impact on incidence rates and preventive measures. Despite this, the study provided a comprehensive analysis of socio-economic factors and state policies affecting oncology services, highlighting areas for SDH management improvement.

Conclusion

The study highlights the need to integrate global best practices into local healthcare systems. Improving education and diagnostics access can boost early detection and reduce mortality. Future research should evaluate the long-term outcomes of these strategies.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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