RESEARCH ARTICLE

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Prostate Cancer Epidemiology In A Central Asian Region After Discontinuation Of Screening: Population-Based Data From Abay, Kazakhstan (2020-2024)

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Abstract

Background: Prostate cancer is one of the most common malignancies among men worldwide, with marked regional variability in incidence, mortality, and stage at diagnosis. Data from Central Asia remain limited, particularly in regions without organized prostate-specific antigen (PSA) screening programs. This study aimed to assess the epidemiology of prostate cancer in the Abay region of Kazakhstan during the post-screening period. **Methods:** A retrospective population-based descriptive study was conducted using official cancer registry data from the Abay region. All newly diagnosed prostate cancer cases (ICD-10 code C61) registered between 2020 and 2024 were included. Incidence, mortality, stage distribution at diagnosis, one-year lethality, prevalence, and the proportion of patients under ≥5-year follow-up in the cancer registry were analyzed using descriptive epidemiological methods. Year-to-year relative changes were used to describe temporal patterns in incidence and mortality. **Results:** A total of 260 new prostate cancer cases were registered during the study period. The incidence rate increased from 7.2 per 100,000 male population in 2020 to 9.2 per 100,000 in 2024, with a peak observed in 2023. In contrast, mortality declined steadily overall from 5.7 to 2.8 per 100,000 over the same period. Stage II disease predominated; however, advanced-stage cancer remained common. The proportion of stage IV disease ranged from 25.8% to 37.5%, indicating persistent late diagnosis. The proportion of patients registered in the cancer registry for ≥5 years increased from 42.1% to 56.4%, and prevalence rose from 55.4 to 63.6 per 100,000, reflecting the accumulation of patients under long-term observation. **Conclusions:** Despite increasing incidence, prostate cancer mortality in the Abay region declined during 2020-2024. However, the persistently high proportion of advanced-stage disease indicates substantial challenges in early detection in the absence of organized screening. These findings describe the current epidemiological profile of prostate cancer in a Central Asian region operating under opportunistic diagnostic practices.

Keywords: Prostate cancer, Epidemiology, Incidence, Mortality, Stage distribution

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Introduction

Prostate cancer (PCa) is among the most common malignancies in men and represents a major public health challenge worldwide. According to GLOBOCAN 2022, more than 1.4 million new PCa cases and approximately 375,000 deaths are registered annually, accounting for about 14% of all newly diagnosed cancers in males. PCa epidemiology exhibits marked geographic heterogeneity, reflecting differences in population age structure, access to healthcare, and early detection practices [1, 2].

Over the past two decades, a sustained increase in PCa incidence has been reported across the Asia-Pacific region, particularly in middle-income countries. This trend has been attributed to population ageing, lifestyle changes, and broader use of prostate-specific antigen (PSA) testing in routine clinical practice [2, 3]. Meanwhile, declines in PCa mortality in many Asian countries have been less pronounced than those observed in Europe and North America, suggesting ongoing challenges related to late diagnosis and uneven access to specialized treatment [2].

Unlike countries with organized national screening programs, many Central Asian states operate under an opportunistic model of PCa detection, in which testing is

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largely initiated by the patient or primary care physician. This approach is associated with substantial variability in stage at diagnosis and a persistently high proportion of patients diagnosed at advanced stages [2, 4]. Population-based evidence on PCa epidemiology in Central Asia remains limited, and regional studies are fragmented.

In Kazakhstan, a pilot population-based PCa screening program was introduced in 2013, based on total PSA testing followed by calculation of the Prostate Health Index (PHI) and biopsy when indicated [5]. The program targeted men aged 50-66 years and led to an increase in the proportion of early-stage diagnoses; however, it also raised concerns regarding overdiagnosis and unnecessary invasive procedures. After completion of the pilot phase (2013–2017), national screening priorities shifted to other cancer sites, and organized PCa screening was discontinued at the national level [4, 5]. Consequently, PCa detection in most regions of Kazakhstan is currently predominantly opportunistic. Accordingly, the period 2020-2024 may be considered a post-screening period.

Under these conditions, analysis of regional epidemiological data in the post-screening period is particularly informative for assessing the real-world implications of policy changes in early detection. The Abay region represents a relevant setting for such an assessment given its demographic characteristics, established oncological care infrastructure, and accumulated experience in long-term follow-up of cancer patients. Nevertheless, recent patterns in PCa incidence, mortality, and stage distribution in the Abay region have not previously been comprehensively summarized or interpreted in the context of international evidence.

Overall, there is a shortage of up-to-date population-based data on PCa burden in Central Asian regions operating outside organized screening programs. Addressing this gap is important both for evaluating regional cancer care performance and for informing evidence-based recommendations to optimize PCa early detection strategies in middle-income Asia-Pacific settings.

Therefore, the aim of this study was to characterize PCa epidemiology in the Abay region during 2020-2024 by assessing patterns in incidence, mortality, stage at diagnosis, one-year lethality, and follow-up indicators, and to interpret these findings in the context of screening policy evolution in Kazakhstan and broader international evidence.

Materials and Methods

Study design

We conducted a retrospective, population-based descriptive study to assess key epidemiological indicators of PCa in the Abay region from 2020 to 2024. The analysis included annual incidence, mortality, stage distribution at diagnosis, one-year lethality, and indicators of long-term follow-up in the cancer registry (≥5 years).

Setting

The study was based on official data from the oncology service of the Abay region, Republic of Kazakhstan, which registers all newly diagnosed malignant neoplasms among residents. Until 2022, the territory formed part of the East Kazakhstan Region; however, the present analysis reflects the current administrative boundaries.

Data sources and eligibility

Data were obtained from primary notification forms for newly diagnosed PCa cases, the regional cancer registry, aggregated state statistical reports, follow-up records, and death records. Inclusion criteria comprised newly established PCa diagnoses (ICD-10 code C61) during 2020-2024. Exclusion criteria comprised duplicate registrations, recurrences, stage changes during treatment, and patients who were not permanent residents of the region.

Outcomes

The following indicators were assessed

(i) PCa incidence (annual number of new cases and crude rate per 100,000 male population);

(ii) PCa mortality (annual number of deaths and crude rate per 100,000 male population);

(iii) stage at diagnosis (distribution across stages I–IV according to the TNM classification as recorded in the cancer registry);

(iv) one-year lethality (proportion of patients who died within the first year after diagnosis);

(v) proportion of patients under ≥5-year follow-up in the cancer registry (calculated among all registered prevalent cases at the end of each year);

(vi) prevalence (number of registered patients under follow-up at the end of each year).

Statistical analysis

Descriptive epidemiological methods were applied. All incidence and mortality rates presented in this study are crude rates calculated per 100,000 male population. Age-standardised rates were not calculated due to the absence of age-stratified population data. For each calendar year, we calculated absolute counts, crude rates per 100,000 population, and year-to-year relative changes and overall temporal patterns based on crude incidence and mortality rates. Assessment of changes over time relied on relative differences and visual inspection. The proportion of patients under ≥5-year follow-up in the cancer registry was calculated among all registered prevalent cases at the end of each year based on direct counting of registry records. Confidence intervals were not calculated due to limited numbers and the administrative nature of the data.

Ethics

The study used de-identified state medical statistics and did not require individual informed consent. The protocol complied with the Declaration of Helsinki principles and national data protection requirements.

Results

Overall prostate cancer burden (2020-2024)

During 2020-2024, a total of 260 new prostate cancer (PCa) cases were registered in the Abay region. The annual

number of newly diagnosed cases ranged from 42 to 44 in 2020-2021, increased to a peak of 66 cases in 2023, and subsequently declined to 56 cases in 2024.

The crude incidence rate increased from 7.2 per 100,000 male population in 2020 to 9.2 per 100,000 in 2024, reaching a peak of 10.8 per 100,000 in 2023 (Table 1). Overall, the average annual change in incidence was positive, indicating an increase in PCa detection in the region during the study period [1].

The most pronounced increase in incidence was observed in 2022-2023, which may reflect a recovery of diagnostic activity following the COVID-19 pandemic and delayed detection of previously undiagnosed cases [6].

Mortality patterns

PCa mortality in the Abay region demonstrated an overall downward trend. The absolute number of deaths decreased from 35 cases in 2020 to 17 cases in 2024, while the crude mortality rate declined from 5.7 to 2.8 per 100,000 male population (Figure 1). One-year lethality also declined over the study period, from X% in 2020 to Y% in 2024.

Throughout the study period, mortality showed a negative average annual change, while incidence increased, reflecting diverging patterns over time. Despite increasing PCa detection, mortality declined, forming an epidemiological pattern commonly observed in regions with gradually improving access to specialized treatment and structured follow-up care [7].

Comparison of incidence and mortality dynamics revealed a pronounced divergence: while incidence increased with year-to-year variability, mortality decreased steadily over the five years. This divergence may reflect improved disease control, broader implementation of modern therapeutic approaches, and accumulation of patients under long-term follow-up, alongside persistent limitations in early detection systems [6, 8].

Stage distribution at diagnosis

Analysis of stage distribution at initial diagnosis did not demonstrate a consistent shift toward earlier-stage disease. Stage II predominated throughout the observation period; however, its proportion varied substantially between years, ranging from 23.2% in 2024 to 64.1% in 2021.

The combined proportion of early stages (I-II) ranged from 51.8% in 2024 to 71.2% in 2023. At the same time, the proportion of patients diagnosed with advanced disease (stages III-IV) remained considerable, accounting for 28.8%-48.2% across the study years (Table 2).

Stage III disease accounted for a smaller but variable proportion of cases, ranging from 2.4% to 11.8%, reflecting heterogeneous patterns of intermediate-stage diagnosis.

A particularly notable finding was the persistently high proportion of stage IV disease, which ranged from 25.8% to 37.5% and remained elevated even in years with increased detection of early-stage PCa. In 2024, the proportion of late-stage disease (III-IV) approached that of early-stage disease (I-II) (48.2% vs 51.8%), indicating a persistently high burden of clinically advanced PCa at diagnosis.

Five-year dispensary registration and prevalence

The number of patients registered in the cancer registry for five years or longer increased from 143 individuals (42.1%) in 2020 to 219 individuals (56.4%) in 2024 (Table 3). The relative increase exceeded 30% over the five years, reflecting the accumulation of patients under long-term registry-based observation and sustained patient retention in oncological care.

PCa prevalence also showed a steady increase, rising from 340 patients (55.4 per 100,000) in 2020 to 388 patients (63.6 per 100,000) in 2024. The increase in prevalence reflects a growing burden on regional oncology services and follow-up systems, as well as accumulation of patients under long-term follow-up [9].

It should be emphasized that the five-year follow-up indicator used in this study reflects administrative registry characteristics and does not represent a standardized survival analysis.

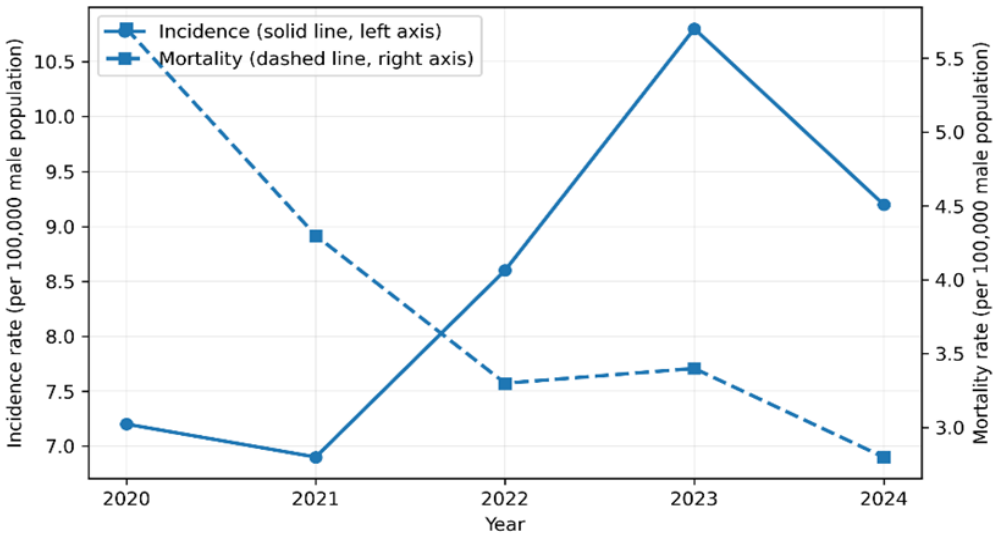

Figure 1. Diverging Patterns in Prostate Cancer Incidence and Mortality in Abay region, 2020-2024.

Table 1. Prostate Cancer Incidence and Mortality in Abay Region, 2020-2024

Year	New cases (n)	Incidence rate (per 100,000)	Deaths (n)	Mortality rate (per 100,000)
2020	44	7.2	35	5.7
2021	42	6.9	26	4.3
2022	52	8.6	20	3.3
2023	66	10.8	21	3.4
2024	56	9.2	17	2.8

Table 2. Stage Distribution of Prostate Cancer at Diagnosis, 2020–2024 (%)

Year	Stage I	Stage II	Stage I-II	Stage III	Stage IV
2020	2.4	59.5	61.9	2.4	35.7
2021	2.5	64.1	66.6	2.6	30.8
2022	3.9	56.8	60.7	11.8	27.4
2023	34.8	36.4	71.2	3	25.8
2024	28.6	23.2	51.8	10.7	37.5

Discussion

This study provides an up-to-date characterization of the epidemiological burden of prostate cancer (PCa) in the Abay region over five years and allows assessment of regional patterns in incidence, mortality, stage distribution, and accumulated prevalence in the absence of organized screening. The findings reflect real-world conditions of PCa early detection in a Central Asian setting and contribute to the limited body of population-based evidence from middle-income countries [7, 10].

During 2020-2024, PCa incidence in the Abay region demonstrated moderate year-to-year variability, with a peak observed in 2023 followed by a decline in 2024. This pattern may be attributed to several factors, including recovery of diagnostic activity after the COVID-19 pandemic, expanded use of PSA testing in clinical practice, and delayed detection of cases that were not diagnosed in earlier years [11, 12]. Similar short-term increases in cancer incidence following the pandemic have been reported in several European and Asian countries, where reductions in access to healthcare during 2020-2021 led to fewer primary cancer diagnoses [1, 13].

When compared with international data, PCa incidence in the Abay region remains lower than in countries with organized PSA screening programs, such as the United States, Canada, and several Western European nations [2, 12]. At the same time, the observed rates are comparable to those reported in other Central and East Asian countries, where PCa detection is predominantly opportunistic [3, 14]. Given the ageing male population, crude rates may underestimate temporal comparability and limit direct comparison with age-standardized international estimates.

PCa mortality in the study region showed an overall decrease over the study period. A reduction in mortality concurrent with increasing or relatively stable incidence represents a typical epidemiological pattern for PCa and has been previously described in multiple Asian and European settings [1, 2]. Potential contributors to this trend include improved access to specialized oncological care, broader use of androgen deprivation therapy and contemporary treatment regimens, and accumulation of patients under long-term follow-up in the cancer registry [15].

Nevertheless, the interpretation of declining mortality warrants caution. The relatively small absolute number of cases and the regional nature of the data render annual estimates sensitive to random variation. Moreover, reduced mortality does not necessarily reflect system-level improvements in early detection, as evidenced by the persistently high proportion of patients diagnosed at advanced stages [16].

Analysis of stage distribution at initial diagnosis did not reveal a sustained shift toward earlier-stage disease. Although in certain years, most notably in 2023, the combined proportion of stages I-II exceeded 60-70%, this share declined to 51.8% in 2024, while the proportion of stage IV disease increased to 37.5%. These observations may reflect a temporary intensification of diagnostic activity rather than true stage migration. The marked increase in stage I diagnoses observed in 2023 should be interpreted with caution and may also be influenced

Table 3. Five-Year Dispensary Registration and Prevalence of Prostate Cancer, 2020–2024

Year	Patients under ≥5-year dispensary registration (n)	Proportion under ≥5-year dispensary registration (%)	Prevalence (n)	Prevalence rate (per 100,000)
2020	143	42.1	340	55.4
2021	162	47.9	338	55.4
2022	189	54.5	347	57.1
2023	207	54.3	381	62.4
2024	219	56.4	388	63.6

by changes in diagnostic practices, reporting procedures, or stage classification within the cancer registry system [14, 17].

The consistently high proportion of stage IV disease indicates the presence of a stable group of men whose cancer is detected only after dissemination. This observation is consistent with data from other Central Asian countries and highlights the limited effectiveness of exclusively opportunistic approaches to PCa detection [3, 14]. In contrast, countries with long-standing PSA screening programs report substantially lower proportions of advanced-stage disease, although these programs remain subject to debate due to concerns regarding overdiagnosis and overtreatment [16, 17].

In this context, the Abay region may be viewed as a "natural experiment" reflecting PCa epidemiology following the discontinuation of organized PSA screening. The results suggest that withdrawal of systematic early detection is associated with a persistently high burden of late-stage disease, despite relative improvements in mortality indicators. These findings are relevant for cancer control policy in middle-income countries, where implementation of population-based screening requires careful evaluation of the balance between potential benefits and harms [18].

The observed increase in prevalence and in the number of patients under follow-up for five years or longer reflects the accumulation of PCa cases and sustained retention of patients in oncological care. However, it should be emphasized that the follow-up indicator used in this study reflects administrative registry characteristics and should not be interpreted as a survival measure. This indicator does not represent patient survival outcomes, and no survival analysis was performed in this study [19]. Nevertheless, similar measures are widely applied in regional epidemiological studies and provide useful insight into the overall burden on healthcare systems [20].

Limitations

Several limitations of this study should be acknowledged. First, the analysis was based on data from a regional cancer registry, which may be associated with incomplete availability of selected clinic pathological variables, including prostate-specific antigen (PSA) levels, Gleason score, and detailed treatment information. Second, the absence of age-stratified population data precluded calculation of age-standardized incidence and mortality rates, thereby limiting direct comparability of the results with international estimates. Third, the relatively small absolute number of cases may increase the influence of random fluctuations on annual indicators. Fourth, changes in administrative boundaries during the study period may have influenced population denominators and, consequently, crude rate calculations. Despite these limitations, this study is valuable as one of the few population-based descriptions of prostate cancer epidemiology in a Central Asian region during the post-screening period. The findings suggest the need for continued improvement of early detection strategies, increased cancer awareness at the level of primary healthcare, and the development of locally adapted diagnostic models that take into account regional resources and demographic characteristics.

In conclusion, this population-based study describes recent epidemiological patterns of prostate cancer in the Abay region of Kazakhstan during 2020-2024. While prostate cancer incidence increased and mortality declined over the study period, a consistently high proportion of advanced-stage disease persisted. These findings indicate ongoing challenges in early detection under predominantly opportunistic diagnostic practices and support the need for continued monitoring of prostate cancer patterns in regions without organized screening programs.

Author Contribution Statement

All authors contributed equally to the conceptualization, methodology, data analysis, and manuscript preparation. All authors have reviewed and approved the final version of the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest. This manuscript has not been published previously and is not under consideration for publication elsewhere.

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