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Original article

Retrospective analysis of tuberculosis incidence in Kazakhstan for 2000-2023

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Abstract

Tuberculosis continues to be one of the most pressing global health issues and the leading cause of death. In 2023, the World Health Organization reported 10.6 million cases globally, emphasizing the persistent burden of tuberculosis. The World Health Organization strategy aims for a 95% reduction in tuberculosis deaths and a 90% reduction in cases by 2035. However, the COVID-19 pandemic negatively impacted tuberculosis diagnosis and treatment worldwide. Despite following the protocols of the National Tuberculosis Program for detection and treatment of tuberculosis, WHO recommendations, Kazakhstan continues to have one of the highest rates of multidrug-resistant tuberculosis in the world.

In our research, we analyzed the tuberculosis incidence in Kazakhstan over a 24-year period, including the regional specifics of disease.

Methods. The study is retrospective - the period under study was 24 years (2000-2023). The material for the study was data on tuberculosis incidence by region, urban and rural areas. Descriptive and analytical methods of epidemiology were used.

Results. According to national statistics data for 2000-2023, more than 357 thousands of patients with a newly diagnosed tuberculosis were identified in Kazakhstan. During the study period Kazakhstan experienced a significant decline of disease. The total tuberculosis incidence rate per 100.000 population fell from 153.2 to 34.7 (92.9±9.8%) (95% CI=73.6-112.1). Significant regional variations were observed across the country. In 2000 the highest levels of tuberculosis incidence per 100,000 population were noted in Kyzylorda (303.3), Mangystau (259.0), Aktobe (231.6) and Pavlodar (201.1) regions. The lowest rate were in Almaty city (72.8). In 2023 the lowest rate per 100.000 population were also found in Almaty city (19.8), the highest tuberculosis rate experienced Kyzylorda (42.5), Atyrau (42.1) regions.

Conclusion. Kazakhstan has made significant progress in reducing the incidence of tuberculosis. However, the continued prevalence of tuberculosis in the country and persistent regional disparities highlight the need for comprehensive and sustainable measures, especially in areas with high rates of the disease.

Keywords: tuberculosis, incidence rate, Kazakhstan, regional differences.

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Introduction

Tuberculosis (TB) remains a significant global health challenge, with notable implications both worldwide and specifically in Kazakhstan. The Mycobacterium tuberculosis complex is a genetically homogeneous group that includes species such as M. tuberculosis, M. africanum, M. bovis, and others. Among these, M. tuberculosis is the most prominent, infecting over one-third of the world's population [1]. In 2023, the World Health Organization's (WHO) Global TB Report estimated 10.8 million incident cases of TB worldwide, underscoring the persistent burden of this disease. The WHO's END TB Strategy aims to reduce TB deaths by 95% and new cases by 90% by 2035 [2].

While the global TB epidemic shows signs of decline, the absolute number of new cases remains high. The burden of TB is disproportionately high in low- and middle-income countries, which account for 98% of TB cases. For instance, India, a key contributor to the global TB burden, accounts for 24% of global cases, 23% of global incident cases, and 21% of TB-related deaths [3,4]. The country is also responsible for 28% of the global TB burden within the South-East Asia region [6]. A national TB prevalence survey conducted between 2019 and 2021 recorded a crude prevalence of 31% in India, reflecting the widespread impact of the disease [6].

TB incidence rates across various WHO regions for 2000-2021 shows the following [2]:

African Region: TB incidence has shown a slight decline, but the rates remain significantly high compared to other regions, reaching around 240-640 cases per 100.000 population.

Region of the Americas: TB incidence has steadily declined, with rates decreasing from around 50 to under 30 cases per 100.000 population.

Eastern Mediterranean Region: The TB incidence remained relatively stable over the period but showed a small rise towards 2021, fluctuating between 100 and 180 cases per 100.000 population.

European Region: There has been a significant reduction in TB incidence in this region, from around 60 to under 30 cases per 100,000 population by 2021.

South-East Asia Region: Although there was a decline in incidence, the region still experiences high TB rates, dropping from around 320 to approximately 200 cases per 100,000 population.

Western Pacific Region: This region has seen a steady decline, with TB incidence rates dropping from around 140 to below 80 cases per 100,000 population.

The COVID-19 pandemic has had a negative impact on access to TB diagnosis and treatment in many countries, in turn resulting in global increases in the burden of TB disease.

TB incidence in different countries varies very much. For example, the lowest TB incidence has such countries as Monaco 0.0, San Marino 0.3, Iceland 2.9, Denmark 3.8 per 100,000 population in 2021. Countries with the highest tuberculosis incidence: Philippines 650, Lesotho 614, Central African Republic 540, South Africa 513 per 100.000 in 2021 [7].

Kazakhstan, one of the 18 high-priority countries for TB control, has made substantial progress in reducing TB incidence. According to Sakko et al. between 2014 and 2019, the incidence rate decreased from 227 per 100,000 population to 69.1 per 100.000. However, the mortality rate remained relatively high, decreasing only slightly from 2.4 per 100.000 in 2018 to 2.0 per 100.000 in 2019 [8]. Despite following the protocols of the National Tuberculosis Program for detection and treatment of TB (1998), WHO recommendations, Kazakhstan continues to have one of the highest rates of Multidrug-Resistant Tuberculosis in the world [9, 10].

The continued prevalence of TB in Kazakhstan highlights the ongoing need for comprehensive and sustained public health interventions. In our research we analyzed the TB incidence in Kazakhstan over a 24-year period, including the regional specifics of disease.

Material and methods

The study is retrospective. The research period was 24 years (2000-2023). The material for the study was taken from the statistical data of World Health Organization [11], statistical data of the Republic of Kazakhstan (www.stat.kz) [12] about TB incidence, considering such factors as place of residence and regional distribution. Descriptive and analytical methods were applied.

The disease rated were calculated per 100,000 population. The geometric mean was used to calculate the average annual growth/loss rate of the dynamics. The extensive, intensive indicators, average values (M,P), the mean error (m), 95% confidence intervals (95%CI), the average annual growth/loss rate of the equalized indicators (Tg/d,%) were calculated [13].

The following abbreviations were used: TB – tuberculosis; WHO-World Health Organization, $^{0}/_{0000}$ – per 100.000 population.

The study was conducted in accordance with all necessary ethical standards and did not involve contact with individuals.

Results

According to national statistics data for 2000-2023 more than 357 thousands of patients with a newly diagnosed tuberculosis were identified in Kazakhstan. During the study period Kazakhstan made significant strides in combating tuberculosis, with newly diagnosed patients decreasing from 22.7 thousand in 2000 to 6.8 thousand in 2023. On figure 2 the normalized indicator of TB incidence shows a more accurate trend of decreasing disease rate per 1.000 of population.

In urban settings, TB incidence decreased from $166.3^{0}/_{0000}$ in 2000 to $33.9^{0}/_{0000}$ in 2023, with an average annual incidence rate of 100.8 per 100.000 (±10.7), 95% CI=79.9-121.7. Rural areas saw a decrease from $136.7^{0}/_{0000}$ to $36.0^{0}/_{0000}$ over the same period, with an average annual incidence rate of 83.1 per 100.000 (±8.8), 95% CI=65.8-100.4 (Figure 1).

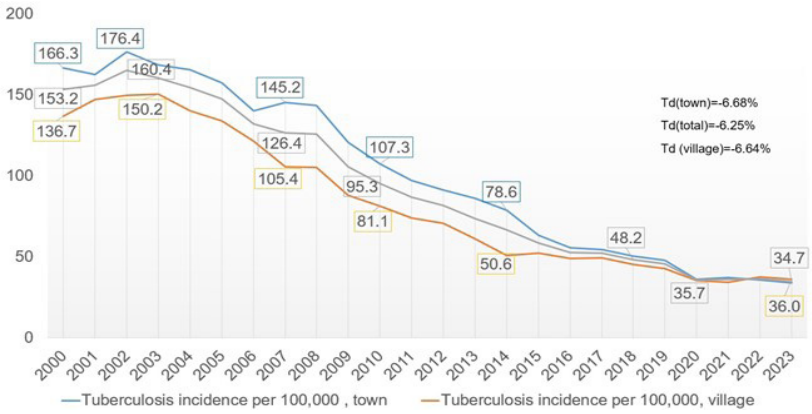

Figure 1 - Tuberculosis incidence rate per 100.000 population for the period 2000-2023 in Kazakhstan

The average annual number of patients was 14885±1333.7 with a 95% confidence interval (CI) ranging from 12,271 to 17,499. This represents a reduction in the incidence rate from 153.2 to 34.7 per 100,000 population. The total incidence rate per 100,000 population fell by an average of 92.9%±9.8%, with a 95% CI of 73.6 to 112.1 (figure 1).



Figure 2 - Tuberculosis crude rate per 1.000 population and equalized indicators per 2000-2003 in Kazakhstan

Table 1 - The regional distribution of TB incidence in Kazakhstan for 2000-2023 per 100.000 population

Regions/years	2000	2022	2023	Reduction in times for 24 years	Reduction in % for 24 years
Republic of Kazakhstan	153.2	31.9	30.7	5.0	-80.0
Abay region	-	-	33.7		
Akmola region	169.7	35.5	34.9	4.9	-79.4
Aktobe region	231.6	33.6	31.4	7.4	-86.5
Almaty region	118.4	31.6	33.5	3.5	-71.7
Atyrau region	177.1	51.9	42.1	4.2	-76.2
East-Kazakhstan region	124.2	37.5	38.3	3.2	-69.2
Zhambyl region	156.4	28.6	30.6	5.1	-80.4
Jetisy	-	-	33.6		
West-Kazakhstan region	186.7	40.5	38.8	4.8	-79.2
Karaganda region	144.7	36.6	33.6	4.3	-76.8
Kostanay region	149.3	45.4	37.7	4.0	-74.8
Kyzylorda region	303.3	42.3	42.5	7.1	-86.0
Mangystau region	259.0	36.6	27.4	9.4	89.4
Pavlodar region	201.1	38.2	37.1	5.4	-81.6
North-Kazakhstan region	143.2	37.5	39.1	3.7	-72.7
Turkestan region	-	21.2	19.8		
Ulytau	-	-	35.2		
Almaty city	72.8	19.1	19.8	3.7	-72.8
Astana city	198.3	30.3	29.9	6.6	-84.9
Shymkent city*	121.1	22.0	22.3	5.4	-81.6

The regional distribution of TB incidence in Kazakhstan for 2000-2023 showed a national decline, highlighting ongoing progress in TB control efforts (Table 1).

However, significant regional variations were observed across the country. In 2000 the highest levels of TB incidence per 100,000 population were noted in Kyzylorda (303.3), Mangystau (259.0), Aktobe (231.6) and Pavlodar (201.1) regions. The lowest rate were in Almaty city (72.8). In 2023 the lowest rate per 100,000 population were also found in Almaty city (19.8), the highest TB rate experienced Kyzylorda (42.5), Atyrau (42.1) regions.

The largest decrease in TB cases was in Mangystau (-89.4%), Shymkent (-81.6%), Pavlodar (-81.6%), Kyzylorda (-86.0%), Aktobe (-86.5%). The smallest decrease was in East-Kazakhstan (-69.2%) and Almaty region (-71.7%). On average, the decrease in Kazakhstan was approximately 80% (Table 1).

Despite these positive trends, certain regions have shown recent upticks in TB rates. Over the past two years, Kyzylorda's TB rate slightly increased from 42.3 to 42.5 per 100,000, and North Kazakhstan saw a rise from 37.5 to 39.1 per 100,000, indicating areas that may require intensified control measures. Urban centers like Almaty and Shymkent reported lower TB rates, likely due to better healthcare access and infrastructure. Overall, while there are positive trends in several regions, the disparities underscore the need for targeted interventions and resources in high-burden areas like Kyzylorda, Atyrau and North Kazakhstan to further reduce TB incidence and improve public health outcomes across the nation.

Discussion

The analysis of TB incidence in Kazakhstan from 2000 to 2023 reveals significant progress in reducing the burden of the disease from 153.2 to 34.7 per 100,000 population, which correspond to the indicators of the WHO European Region [2]. These trends reflect significant progress in TB control and treatment strategies in Kazakhstan, underscoring the importance of sustained public health efforts.

Despite this progress, regional disparities persist, with Kyzylorda, Atyrau, and North Kazakhstan regions exhibiting higher TB incidence rates in 2023, emphasizing the need for targeted interventions.

A notable aspect of this decline is the disparity between urban and rural areas [14-16]. Since 2020, the incidence rates in urban and rural areas have converged, possibly due to the impact of the COVID-19 pandemic [17,18].

Globally, TB caused approximately 1.25 million deaths in 2023, reclaiming its position as the leading infectious disease killer. TB-related deaths decreased slightly from 1.32 million in 2022 to 1.25 million in 2023 [2]. However, TB has likely returned to being the world's leading cause of death from a single infectious agent, surpassing COVID-19 [17,18].

According to WHO dates TB mortality rates in Kazakhstan for 2000-2021 showed a sharp decline in total TB-related deaths over the years, starting with 3,909 deaths in 2000, steadily decreasing to 356 by 2021. Deaths number among males consistently higher than females. Thus, in 2000 the number was 3.8 times higher (3,109 males and 800 females), in 2021 the index was 3.3 times higher (273 males and 83 females) [19].

The 2025 milestones of WHO's End TB Strategy are a 50% reduction in the TB incidence rate (2015-2025) and a 75% reduction in the number of TB deaths (2015-2025). More than 74 million lives had been saved through TB prevention, diagnosis and treatment since 2000 worldwide. But the global targets are currently not on track. The most obvious and immediate impact of disruptions caused by the COVID-19 pandemic globally was a large fall in the number of people newly diagnosed with TB and reported (i.e. officially notified), due to reduced provision of TB services [2].

Thus, comprehensive and sustained public health interventions in Kazakhstan to achieve global TB control are needed, which include:

1. *Strengthening Preventive Measures*

- Expanding vaccination programs, including maximum coverage of the BCG vaccine, particularly in high-burden regions.

- Organizing educational campaigns for early detection and prevention of disease spread.

2. *Improving Diagnosis and Treatment*

- Ensuring access to modern diagnostic methods, including molecular tests, especially in rural areas.

- Implementing innovative treatment regimens in accordance with WHO recommendations and ensuring adherence.

3. *Reducing Regional Disparities*

- Paying special attention to high-incidence regions such as Kyzylorda, Atyrau, and North Kazakhstan.

- Developing specialized programs for urban and rural areas aimed at reducing disparities in TB incidence rates.

4. *Strengthening the Healthcare System*

- Establishing an effective tuberculosis monitoring system for timely detection and response.

- Conducting medical staff training to enhance the quality of diagnosis and treatment.

5. Minimizing the Impact of Pandemic infectious disease

- Ensuring uninterrupted access to tuberculosis diagnosis and treatment even in crisis situations.

- Integrating tuberculosis control programs into broader infectious disease management strategies.

6. *Active Community Engagement*

- Conducting awareness campaigns on TB transmission routes, symptoms, and the importance of timely treatment.

- Collaborating with local organizations to increase public awareness and health-seeking behavior.

7. *Government Support and International Cooperation*

- Allocating additional funding for tuberculosis control and attracting investment.

- Developing legislative initiatives to ensure access to treatment for vulnerable populations.

Conclusion

While the declining trend in TB incidence and mortality demonstrates the effectiveness of national health strategies, continued efforts are necessary to address remaining regional challenges and sustain progress. Strengthening healthcare infrastructure, improving early diagnosis, and ensuring equitable access to treatment will be crucial in further reducing TB prevalence in Kazakhstan and aligning with global TB elimination goals.

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Authors' contributions. D.K. – conceptualization, collection of data, design, control, writing the text of the article, approval of the final version of the article; I.P., M.J. – analysis of the material, writing the text of the article. All authors read, agreed to the final version of the manuscript, and signed the copyright transfer form.

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2000-2023 жылдардағы Қазақстандағы туберкулезбен сырқаттанушылықты ретроспективті талдау

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Түйіндеме

Туберкулез денсаулық сақтаудың ең өзекті жаһандық проблемаларының бірі және өлімнің негізгі себебі болып қала береді. 2023 жылы Дүниежүзілік денсаулық сақтау ұйымы дүние жүзінде 10,6 миллион жағдай туралы хабарлады, бұл туберкулездің жалғасып жатқан ауыртпалығын көрсетеді. Дүниежүзілік денсаулық сақтау ұйымының стратегиясы 2035 жылға қарай туберкулезден өлім-жітімді 95%-ға және аурушаңдықты 90%-ға төмендетуге бағытталған. Дегенмен, COVID-19 пандемиясы бүкіл әлем бойынша туберкулезді диагностикалау мен емдеуге теріс әсер етті. Туберкулезді анықтау және емдеу жөніндегі Ұлттық туберкулез бағдарламасының хаттамаларына және ДДҰ ұсынымдарына сәйкестігіне қарамастан, Қазақстан әлі де әлемде көптеген дәрілерге төзімді туберкулездің ең жоғары көрсеткіштерінің бірі болып табылады.

Біз өз зерттеуімізде Қазақстанда 24 жыл ішінде туберкулезбен аурушаңдық, оның ішінде аурудың аймақтық ерекшеліктеріне талдау жасадық.

Әдістері. Зерттеу ретроспективті, зерттелген кезең 24 жыл (2000-2023) болды. Зерттеуге арналған материал облыстар, қалалар және ауылдық жерлер бойынша туберкулезбен сырқаттанушылық деректері болды. Эпидемиологияның сипаттамалық және аналитикалық әдістері қолданылды.

Нәтижесі. 2000-2023 жылдардағы ұлттық статистика мәліметтеріне сәйкес, Қазақстанда алғаш рет анықталған туберкулезбен 357 мыңнан астам науқас тіркелген. Зерттелген кезең ішінде елде туберкулездің сырқаттанушылық деңгейі айтарлықтай төмендеген. Жалпы сырқаттанушылық көрсеткіші 100 000 адамға шаққанда 153,2-ден 34,7-ге дейін (92,9±9,8%) (95% СИ=73,6-112,1) азайды. Ел аумағында аймақтық айырмашылықтар едәуір байқалды. 2000 жылы туберкулезбен сырқаттанушылықтың ең жоғары деңгейі 100 000 тұрғынға шаққанда Қызылорда (303,3), Маңғыстау (259,0), Ақтөбе (231,6) және Павлодар (201,1) облыстарында тіркелді. Ең төменгі көрсеткіш Алматы қаласында (72,8) болды. 2023 жылы ең төменгі көрсеткіш 100 000 адамға шаққанда Алматы қаласында (19,8) тіркелсе, ең жоғары сырқаттанушылық деңгейі Қызылорда (42,5) және Атырау (42,1) облыстарында байқалды.

Қорытынды. Қазақстан туберкулезбен сырқаттанушылықты төмендетуде айтарлықтай жетістіктерге жетті. Дегенмен, елде туберкулездің таралуының жалғасуы және тұрақты аймақтық теңсіздіктер, әсіресе аурумен ауыратын аймақтарда жан-жақты және тұрақты әрекет ету қажеттілігін көрсетеді.

Түйін сөздер: туберкулез, аурушаңдық, Қазақстан, аймақтық айырмашылықтар.

Ретроспективный анализ заболеваемости туберкулезом в Казахстане за 2000-2023 годы

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Резюме

Туберкулез продолжает оставаться одной из наиболее острых глобальных проблем здравоохранения и основной причиной смертности. В 2023 году Всемирная организация здравоохранения сообщила о 10,6 миллионах случаев заболевания во всем мире, подчеркнув сохраняющееся бремя туберкулеза. Стратегия Всемирной организации здравоохранения направлена на сокращение смертности от туберкулеза на 95% и снижение заболеваемости на 90% к 2035 году. Однако пандемия COVID-19 негативно повлияла на диагностику и лечение туберкулеза во всем мире. Несмотря на соблюдение протоколов Национальной программы по борьбе с туберкулезом по выявлению и лечению туберкулеза, рекомендаций Всемирной организации здравоохранения, в Казахстане по-прежнему сохраняется один из самых высоких показателей туберкулеза в мире с множественной лекарственной устойчивостью.

В нашем исследовании мы проанализировали заболеваемость туберкулезом в Казахстане за 24-летний период, включая региональные особенности заболевания.

Методы. Исследование - ретроспективное, изучаемый период составил 24 года (2000-2023 гг.). Материалом для исследования послужили данные о заболеваемости туберкулезом в разрезе регионов, городской и сельской местности. Использовались дескриптивные и аналитические методы эпидемиологии.

Результаты. По данным национальной статистики за 2000-2023 годы в Казахстане выявлено более 357 тысяч больных с впервые выявленным туберкулезом. За исследуемый период в Казахстане наблюдалось значительное снижение заболеваемости туберкулезом. Общий показатель заболеваемости на 100 000 населения снизился с 153,2 до 34,7 (92,9±9,8%) (95% ДИ=73,6-112,1). По стране наблюдались значительные региональные различия. В 2000 году самые высокие уровни заболеваемости туберкулезом на 100 000 населения были отмечены в Кызылординской (303,3), Мангистауской (259,0), Актюбинской (231,6) и Павлодарской (201,1)

областях. Самый низкий показатель выявлен в городе Алматы (72,8). В 2023 году самый низкий показатель на 100 000 населения был также зафиксирован в городе Алматы (19,8), самые высокие показатели заболеваемости туберкулезом зафиксированы в Кызылординской (42,5) и Атырауской (42,1) областях.

Выводы. Казахстан добился заметных успехов в снижении заболеваемости туберкулезом. Однако, продолжающаяся распространенность туберкулеза в стране, сохраняющиеся региональные различия подчеркивают необходимость комплексных и устойчивых мер, особенно в областях с высоким уровнем заболеваемости.

Ключевые слова: туберкулез, заболеваемость, Казахстан, региональные различия.