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Epidemiology of glomerular diseases in Kazakhstan during the period of 2014-2019: data from the Unified national electronic healthcare system

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Abstract

Brief Description: The investigation of glomerular disease prevalence is vital for comprehending chronic kidney disease development, particularly in regions like Kazakhstan and Central Asia, where confirming data is lacking. This study focuses on the epidemiology of glomerular diseases, utilizing registered cases of glomerular diseases in the national electronic health system.

Research Methods: The research involves data from 31,421 patients recorded in the Unified National Electronic Healthcare System database, covering glomerular diseases with ICD-10 codes N01-N08 between 2014 and 2019. Descriptive statistics encompass demographic characteristics, all-cause mortality, prevalence and incidence rates, and comorbidities.

Results: Results reveal a substantial rise in diagnosed cases from 7,756 (2014) to 30,686 (2019), with corresponding all-cause mortality increasing from 254 to 1,025. Also, new cases went up from 4,875 (2014) to 6,320 (2019). Over the period, 51% were women, 49% were men, and 67% were of Kazakh ethnicity. Russian nationality constituted 16%, and other ethnic groups comprised 17%. Diabetes mellitus emerged as the primary comorbidity, associated with 20% of cases.

Conclusion: This is the first descriptive study in Central Asia scrutinizing the epidemiology of patients with glomerular diseases (ICD-10 code N01-N08) using administrative healthcare data in Kazakhstan. The findings indicate an escalation in prevalence and mortality, coupled with a gradual increase in incidence among glomerular disease patients from 2014 to 2019. The study underscores the pivotal role of diabetes mellitus as a predominant comorbidity in this context.

Keywords: glomerular disease, prevalence, comorbidity, incidence, Kazakhstan.

Introduction

Glomerular diseases constitute a group of relatively rare immunomediated disorders characterized by damage to the glomerular compartment of renal nephrons [1]. Glomerular disease can be triggered by various inflammatory conditions such as vasculitis and systemic lupus erythematosus, or infections such as streptococcal, HIV, hepatitis B and C, and endocarditis [2]. One of the most common negative consequences of poorly controlled glomerular disease is the development of chronic kidney disease, eventually requiring renal replacement therapy [3]. In the United States, glomerular disease accounts for 10-15% of end-stage renal failure cases, often leading to comorbidities [4, 5].

Reports indicate that 10% of dialysis patients suffer from chronic glomerular disease, making it the third most common cause of end-stage renal failure in the U.S., surpassed only by hypertension and diabetes mellitus [6]. However, in Kazakhstan and Central Asian countries, glomerular diseases are considered the primary cause of terminal kidney failure, although there is a lack of confirming data.

According to data from the American Medicare program cohort, 18.7% of German citizens with chronic kidney disease and 30–36% of children and adolescents in the U.S. with end-stage renal failure are attributed to glomerular disease. Additionally, several ethnic groups, including African Americans, Hispanics, Asians, and Indigenous peoples in Australia and Canada, have a higher likelihood of developing glomerular disease, which may also be more severe in these populations [4]. However, there is limited data for Kazakhstan regarding the role and prevalence of glomerular disease in the development of terminal chronic kidney failure.

Apart from the prevalence of glomerular disease, the financial costs of patient medical care and treatment play a crucial role in the increasing significance of the disease. The common pathogenetic mechanism for glomerular disease is immunomediated, involving both humoral and cellular responses [5]. Depending on the cause of glomerular disease, treatment may include various methods, including the administration of immunosuppressants, steroids, monoclonal antibodies, and plasmapheresis [5]. Immunosuppressants typically cost between $10,000 and $14,000 annually.

Managing glomerular disease entails not only healthcare but also a financial burden for both the patient and the state. In Kazakhstan, the government provides free medications for patients with glomerular disease. As one of the burdensome medical conditions, the epidemiology of glomerular disease in Kazakhstan will be explored in this study. Therefore, studying the prevalence and incidence of glomerular pathology in the population is crucial for assessing the need for immunosuppressive therapy. The aim of this study is to investigate the epidemiology of glomerular diseases using registered cases of glomerular disease in a Unified National Electronic Healthcare System.

Methodology

Study Population

The study included patients entered into the database of the Unified National Electronic Healthcare System. Initial data on 31,421 patients with glomerular diseases with ICD-10 codes N01-N08 from 2014 to 2019 were extracted from the database in Microsoft Excel format. The flow-chart diagram of cohort set-up (data management and cleaning) is presented in Figure 1. The annual incidence of glomerular diseases was presented in a graphical format. The number of deaths per year was also shown on the graph. Detailed information on data sources is provided in the supplementary material. The total population in Kazakhstan and its regions was obtained from the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan (2019) [7].

Exposure and Covariates

Individual patient data included age, gender, ethnicity, place of residence, comorbidities, and outcomes. Information on age and death (if applicable) was obtained through linkage with the Population Registry using the Registry Number (RPN number). Age was categorized into five groups (under 18 years, 18–34 years, 35–50 years, 51–70 years, and over 70 years), ethnic groups included Kazakhs, Russians, and others (including Uzbeks, Uighurs, Ukrainians, Koreans, and 37 other ethnic groups). Comorbidities were categorized as hypertension, diabetes mellitus, cardiovascular diseases, heart failure, atherosclerotic heart disease, cerebrovascular events/transient ischemic attacks, peripheral vascular disease, and chronic obstructive pulmonary disease. Comorbidities are mutually exclusive among the study patients.

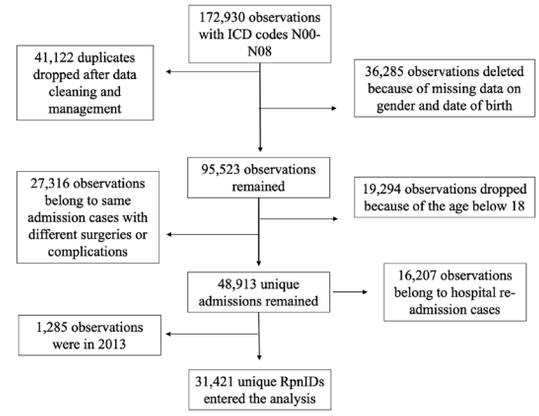

Figure 1 - Flow-chart of cohort set-up

Outcome Assessment

The prevalence, incidence, and overall mortality of patients were studied. The prevalence of glomerular disease patients was examined over six consecutive years (2014–2019). The number of incident cases of glomerular disease was obtained from the Unified National Electronic Healthcare System database. For each year, the periodic prevalence per 100,000 population was calculated by dividing the number of cases of glomerular disease by the population of that year, multiplied by 100,000, and presented on a graph. Similarly, the overall mortality rate in Kazakhstan per 100,000 population was calculated and presented on a graph. Data on overall mortality and corresponding dates were obtained from the Republican Center for Healthcare Development (RCHD) and the population registry. Incidence rates of glomerular disease were calculated by dividing the number of new cases by the population of that year and multiplying by 100,000. Population data for Kazakhstan and its regions were obtained from the Statistics Committee (2019) [7].

Statistical analysis

The data are presented as percentages for categorical variables. Incidence, prevalence, and all-cause mortality rates were calculated by dividing absolute numbers by the population size of the corresponding year and multiplying by 100,000. Population sizes for each year were obtained from the Statistics Committee within the Ministry of National Economy of the Republic of Kazakhstan[7]. The association between variables was tested using the Chi-squared test after checking for corresponding assumptions. The significance level was set at 0.05. Data cleaning, which involved identifying and removing duplicate cases, as well as data management tasks such as labeling all data, creating new variables, and categorizing them, were carried out using STATA version 16.1. Data visualization was conducted using GraphPad Prism version 9.5.

Results

Demographic Data

Demographic information regarding the cohort is presented in Table 1. From 2014 to 2019, a total of 15,970 (51%) females and 15,451 (49%) males were registered with a diagnosis of glomerular disease. Ethnically, 67% of the patients were of Kazakh origin, 16% were of Russian nationality, and 17% belonged to other ethnic groups.

Table 1 Baseline characteristics of the population

	Total (n = 31,421)	Female (n = 15,970; 51%)	Male (n = 15,451; 49%)	p-value
Age, n (%)				<0.001
=< 17 y.o.	9,024 (29)	3,822 (24)	5,202 (34)	
18-34 y.o.	5,042 (16)	2,431 (15)	2,611 (17)	
35-50 y.o.	4,833 (15)	2,387 (15)	2,446 (16)	
51-70 y.o.	9,804 (31)	5,596 (35)	4,208 (27)	
>= 71 y.o.	2,718 (9)	1,731 (11)	984 (6)	
Ethnicity, n (%)				<0.001
Kazakh	20,993 (67)	10,363 (65)	10,630 (69)	
Russian	5,074 (16)	2,909 (18)	2,165 (14)	
Other	5,354 (17)	2,698 (17)	2,656 (17)	
Living area, n (%)				<0.001
Urban	19,762 (64)	10,240 (65)	9,522 (63)	
Rural	11,124 (36)	5,428 (35)	5,642 (37)	
Comorbidities, n (%)				
HTN	4,534 (14)	2,588 (16)	1,946 (13)	<0.001
DM	6,193 (20)	3,771 (24)	2,422 (16)	<0.001
CVD	4,673 (15)	2,415 (15)	2,258 (15)	0.206
HF	1,609 (5)	757 (5)	852 (6)	0.002
ASHD	1,376 (4)	669 (4)	707 (5)	0.094
Dysrhythmia	284 (1)	96 (1)	188 (1)	<0.001
CVA/TIA	742 (2)	382 (2)	360 (2)	0.717
PVD	1,088 (3)	687 (4)	401 (3)	<0.001
COPD	757 (2)	348 (2)	409 (3)	0.007
Liver Disease	259 (1)	114 91)	145 (1)	0.028
Outcome, n (%)				0.620
Alive	27,404 (87)	13,943 (87)	13,461 (87)	
Deceased	4,017 (13)	2,027 (13)	1,990 (13)	

Abbreviations: HTN – hypertension, DM – Diabetes Mellitus, CVD – cardiovascular disease, HF – heart failure, ASHD - Atherosclerotic Heart Disease, CVA/TIA - Cerebrovascular Accident / Transient Ischemic Attack, PVD - Peripheral Vascular Disease, COPD - Chronic Obstructive Pulmonary Disease

Prevalence and Incidence per 100,000 Population

The prevalence and incidence in 2014 were 45.1 and 28.4 per 100,000 population, respectively. These figures differed from the data in 2019 (166.8 and 34.4, respectively) (Figure 2b and 3b). The absolute number of patients with a confirmed diagnosis sharply increased from 7,756 to 30,686 between 2014 and 2019 (Figure 2a). Additionally, the number of new cases increased from 4,875 in 2014 to 6,320 in 2019 (Figure 3a).

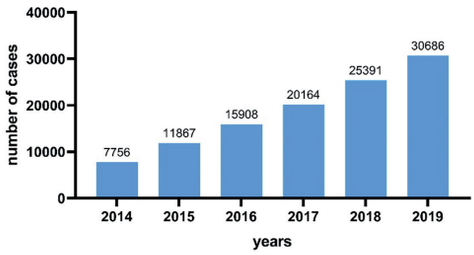

Figure 2a - Absolute values of prevalence of Glomerular Diseases in Kazakhstan between 2014-2019 years

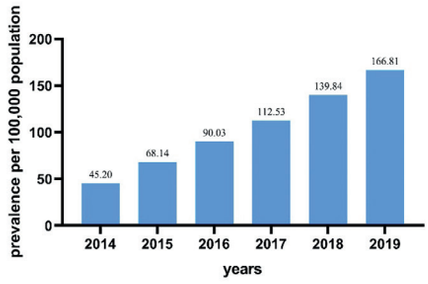

Figure 2b - Prevalence of Glomerular Diseases per 100,000 population in Kazakhstan between 2014-2019 years

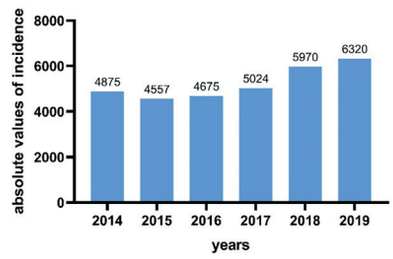

Figure 3a - Absolute values of incidence of Glomerular Diseases in Kazakhstan per each year between 2014-2019

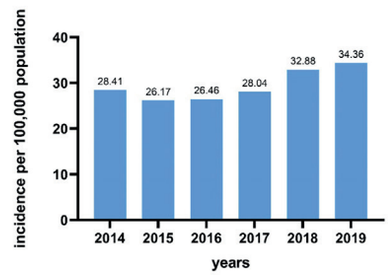

Figure 3b - Incidence rate of Glomerular Diseases per 100,000 population in Kazakhstan between 2014-2019

All-cause Mortality per 100,000 Population

Figure 3b illustrates the all-cause mortality per 100,000 population from 2014 to 2019. The all-cause mortality in 2014 was 1.48 per 100,000 population, increasing to 5.57 in 2019. This significant rise is also evident in the absolute mortality values for 2014 and 2019, which were 254 and 1,025, respectively (Figure 4a).

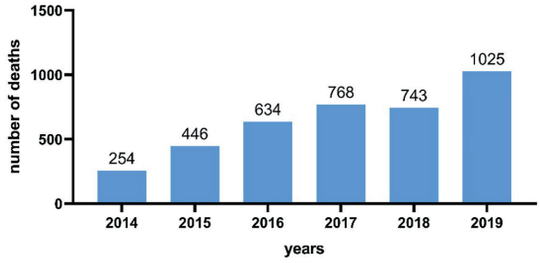

Figure 4a - Absolute numbers of all-cause mortality in Kazakhstan between 2014-2019 years

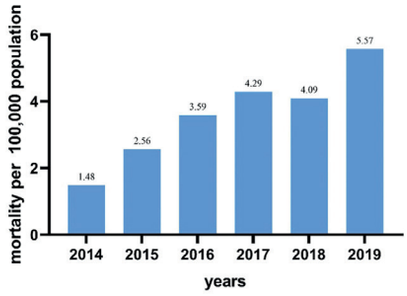

Figure 4b - All-cause mortality per 100,000 population in Kazakhstan between 2014-2019 years

Discussion

This is the first Central Asian study investigating the epidemiology of patients with glomerular diseases using administrative health data recently provided in Kazakhstan. The results of this study demonstrated an increase in the prevalence and mortality, as well as in the incidence of patients with glomerular disease from 2014 to 2019. In this patient cohort, diabetes mellitus was the most prevalent comorbidity associated with glomerular diseases. The majority of patients belonged to the age category of 51–70 years. Additionally, the overwhelming majority of patients (64%) resided in urban regions.

The increasing prevalence of glomerular diseases in Kazakhstan highlights an urgent public health issue that requires comprehensive investigation. Upon meticulous examination of potential risk factors, the interplay of genetic predisposition, aging, environmental influences, and socio-economic factors emerges as a complex nexus contributing to the growing burden of glomerular diseases [8]. As diagnostic challenges persist and treatment accessibility remains inconsistent, it is recommended to explore more precise screening methods, such as kidney biopsies for patients, and establish a national registry based on biopsy results [9]. Patients with glomerular disease in this study were collected solely based on their ICD-10 codes, which were assigned by patients' blood sample analysis. However, for more accurate diagnostic studies, patients should undergo kidney biopsy and be registered in a database, as practiced in more developed countries [9].

Our previous preliminary research revealed that glomerular diseases constitute only 9% of all causes of CKD, while arterial hypertension, along with other cardiovascular diseases and diabetes, accounts for the majority of CKD at 44%, 31%, and 11%, respectively [10]. Nevertheless, the diagnostic and treatment costs for glomerular diseases necessitate significant financial investments in healthcare, considering the morphological verification of the diagnosis and prolonged immunosuppressive therapy [11].

In a meta-analysis of kidney biopsy registries, researchers identified 16 major national catalogs worldwide, including Europe, South America, Asia, and Canada [12]. Notably, none of these catalogs includes Kazakhstan; currently, the country lacks a registry of morphologically verified glomerular disease cases. Based on kidney biopsy results, immunosuppressants and other forms of therapy are typically prescribed. Such data can predict the need for patients' immunosuppressants and medication requirements.

The study also points to an increase in all-cause mortality in Kazakhstan, necessitating a comparative analysis with other similar countries to understand the underlying factors contributing to this trend. The prevalence of non-communicable diseases, such as cardiovascular and respiratory diseases, may significantly contribute to the higher mortality rates in Kazakhstan compared to countries with similar demographic and socio-economic indicators.

The observed increase in incidence can be explained by several factors such as the prevalence of hypertension and diabetes, the aging population, poor diagnosis practices, poor data accuracy, and infectious diseases. More effective preventive measures and public health interventions can curb disease onset, potentially leading to a decline in incidence. Increasing public awareness and educational campaigns promoting a healthy lifestyle and risk-reduction strategies can influence population behavior, thereby reducing the overall risk of new cases [13]. However, it is important to note that while an increase in incidence signifies poor disease prevention and management, the simultaneous increase in disease prevalence suggests that affected patients are living longer with the condition. This shift underscores the need for a thorough understanding of disease dynamics, considering not only the frequency of new cases but also the duration and impact of the disease on affected individuals.

Various factors contribute to the fact that most patients reside in urban areas. Urban regions often have higher population density and expanded access to medical facilities, which can lead to increased awareness, diagnosis, and disease information dissemination [14].

The prevalence of comorbidities among individuals with glomerular diseases in Kazakhstan presents a compelling picture, demonstrating the relationship between kidney health and systemic diseases. Notably, diabetes mellitus is the primary comorbidity, illustrating an interesting link between glomerular diseases and metabolic disorders [15]. The high incidence of diabetes in this context not only exacerbates the burden of lifestyle-related diseases but also underscores the bidirectional influence between kidney function and metabolic health.

Furthermore, cardiovascular diseases are the second most prevalent comorbidity, emphasizing the profound consequences of glomerular diseases for the cardiovascular system. The connection between glomerular diseases and cardiovascular complications can be explained by common risk factors and underlying pathophysiological mechanisms. It is known that patients with glomerular disease develop common cardiovascular risk factors such as hypertension and hyperlipidemia. A study by Hutton et al. (2017) demonstrated that patients with glomerular disease, chronic kidney disease (CKD), and reduced estimated glomerular filtration rate (eGFR), not receiving active immunosuppressive therapy, face a significant three-year risk of cardiovascular events (9.2%). However, this risk seems to be substantially similar to CKD patients with similar characteristics but without glomerular diseases. This suggests that the increased risk of cardiovascular diseases in patients with glomerular disease may be associated with pre-existing cardiovascular risk factors and kidney function levels rather than the glomerular disease itself [16].

Hypertension, as the third most common comorbidity, highlights the mutual relationship between elevated blood

pressure and renal insufficiency [17]. The interaction between glomerular diseases and hypertension creates additional challenges for effective treatment and requires a comprehensive approach to addressing both conditions. This triad of common comorbidities - diabetes, cardiovascular diseases, and hypertension - calls for the development of comprehensive healthcare strategies aimed not only at kidney health but also at a broader spectrum of systemic diseases, facilitating integrated treatment and improved outcomes for people suffering from glomerular diseases in Kazakhstan.

The study is limited by certain factors, including the absence of a morphological diagnosis and kidney biopsy in the examined patients. Additionally, recorded ICD-10 codes based on blood samples may contain inaccuracies arising from human errors and may not truly reflect the actual epidemiological trends of glomerular disease. Therefore, it is crucial to further validate the study results by comparing them with the actual kidney biopsy results of patients. The retrospective design of the study may introduce inherent limitations, as it relies on previously recorded data, potentially leading to incomplete or inconsistent information. Prospective studies may offer more robust data collection and reduce the impact of retrospective limitations. Another limitation was that the study didn't have data on patient history about medical records, medication usage, or lifestyle factors that could impact the depth of the study findings.

Conclusion

The study examined the morbidity, prevalence of glomerular diseases, and all-cause mortality in Kazakhstan from 2014 to 2019. The most common comorbidities with glomerular disease in the Kazakhstani population were diabetes mellitus, cardiovascular diseases, and hypertension. Over this period, there was a significant increase in prevalence and the number of deaths from all causes, and an increase in the incidence rate. This research demonstrated the need for more precise diagnostic methods such as kidney biopsy and morphological verification of the diagnosis. These methods can enhance kidney disease screening, preventing its progression into a chronic form and predicting the need for immunosuppressive therapy.

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