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Seasonal and epidemiological profile of chickenpox cases in Kazakhstan

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Abstract

Background: According to the National infectious disease monitoring report, there is a fluctuating pattern of incidence of chickenpox in the country, but there are no studies reporting the epidemiological situation in Kazakhstan. There is a discernable association of varicella epidemiology with climate, particularly temperature dependency. We aimed to analyze the incidence and seasonality of chickenpox in the absence of universal varicella vaccination in Kazakhstan.

Material and methods: A retrospective analysis of the long-term dynamics of chickenpox was carried out, and data of registered patients between 2010 and 2020 were retrieved from the National infectious disease monitoring report and the Unified Payment System (UPS) database from 2014 to 2020, which is part of the Unified National Electronic Health System (UNEHS).

Results: The highest incidence rate for the studied period was registered in 2014 – 363.96 and the lowest was in 2020 – 95.8 per 100,000 population. Overall, 17,520 cases of chickenpox were recorded with an incidence rate of 95.8 per 100,000 population in the country in 2020 (against 41,841 cases, with an indicator of 228.9 in 2019). The highest proportion of cases is observed among children from 4 to 6 years old (29%), children from 1 to 3 years old (24%) and from 7 to 9 years old (15%). Similar to previous years, there was an autumn-winter spreadingof morbidity, with the highest registration of morbidity in January.

Conclusion: Based on our study, the highest incidence rate of chickenpox in Kazakhstan was registered in 2014 (363.96 per 100,000 population) and morbidity was distributed in the autumn-winter season. These findings might aid in forecasting future outbreaks of infection based on the influence of climate change on chickenpox, and help in making a decision about the implementation of varicella preventive and control initiatives in the country.

Key words: infectious diseases, epidemiology, chickenpox, Kazakhstan

Introduction

Varicella, also known as chickenpox, is a highly contagious disease [1] caused by the *varicella-zoster virus* (VZV). It is considered as a self-limited disease of childhood, but can result in hospitalization and death [2,3]. It is primarily transmitted from person to person through direct contact or inhalation of aerosolized droplets from vesicular rash or respiratory tract secretions of patients with varicella [4]. In the absence of a varicella vaccination (VV), almost everyone is expected to be infected by mid-adulthood [5]. The incidence of varicella is difficult to ascertain as it is a non-reportable disease, and may vary depending on the immunization coverage in different countries.The global impact of the VV program reported the implementation of VV in 36 countries in 2019 [6], mostly comprised of developed countries. None of the Central Asian countries, including Kazakhstan, embraced the VV in the immunization calendar yet [7]. WHO recommends close surveillance of epidemiological situations to assess the health burden of VZV to evaluate the potential need for VV [8].

There is a discernable association of varicella epidemiology with climate, particularly temperature dependency[9]. This could be attributed to biological characteristics of the VZV virus which is inactivated by high temperatures or a humid environment [10]. This can be observed in studies demonstrating different ages-specific incidences of VZV in various climate zones. For example, in temperate climates the reported average age of affected individuals was early childhood (less than 9 years of age) [10,11] with the majority of people infected by the adolescent years. In tropical countries, age-specific incidence was higher, most commonly affecting adolescents and adulthood [12]. The incidence of chickenpox was associated with temperature, latitude, and seasons, and climatic variables should be considered as one of the important prognostic predictors of varicella incidence in Asia [13-15].

Based on the WHO report, seasonality influences the VZV outbreak process: the highest incidence rates correspond to winter and spring seasons [16]. The occurrence of chickenpox is normally increased every 2-4 years, although VZV immunization is not widespread [5]. The age range of 3-6 years has the highest incidence overall, indicating that chickenpox remains primarily a childhood virus. The epidemic phase of acute morbidity outbreaks can be seen, whereas outbreaks are reported not only in organized preschool and school groups but also among military conscripts and in health care institutions (nosocomial outbreaks); a substantial part of chickenpox detection and severe cases are documented in people over the age of 14.

Kazakhstan is a vast and sparsely populated country with a temperate climate. There are no studies reporting the incidence of *Varicella zoster virus* in the country, and the current epidemiological situation of chickenpox or shingles is unknown. Hence, this population-based study aims to assess data from the National infectious disease monitoring report and the UPS to show the country-wide epidemiologic and seasonal profile of chickenpox in the absence of universal varicella immunization. We expect our research to increase understanding of chickenpox distribution dynamics throughout the country, resulting in better evidence-based decisions in prevention, diagnosis, and treatment.

Material and methods

Study population and data sources

This is a retrospective study of the Kazakhstani population diagnosed with VZV according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) from 2010 to 2020. The diagnosis of patients included in the present analysis was identified by the following ICD-10 code for chickenpox: B01-B01.9.

The official data of registered patients between 2010 and 2020 were retrieved from the National infectious disease monitoring report and the UPS database from 2014 to 2020, which is part of the Unified National Electronic Health System (UNEHS).

Exposures and covariates

The registry included data on dates of admission, regions, RPN ID, ICD-10 codes, and incidence rates. Regions were divided into big cities of republican significance (Nur-Sultan, Almaty, and Shymkent cities), North Kazakhstan (Kostanay, Akmola, Pavlodar, and North Kazakhstan regions), South Kazakhstan (Kyzylorda, Turkestan, Zhambyl and Almaty regions), Central Kazakhstan (Karaganda region), East Kazakhstan (East Kazakhstan region) and West Kazakhstan (Atyrau, Aktobe, Mangystau, and West Kazakhstan regions).

Outcome assessment

The incidence rates and patterns of seasonality were assessed. The incidence rate was calculated by dividing the new disease cases during the same period by the population size during the same time x 100,000. Seasonality was tracked using the number of new cases each month from 2014 to 2020, as well as an epidemiological week graph for the last years due to a larger number of recorded patients.

Data were represented as descriptive, with absolute values and percentages generated for categorical variables. Incidence rates within the population are given per 100,000 population.

The study was approved by the Institutional Review and Ethics Committee (NU-IREC 315/21092020 on 23/09/2020) with an exemption from informed consent.

Results

Chickenpox

The frequency of decline and increase in the incidence of chickenpox is highlighted in the long-term dynamics of the incidence from 2010 to 2020. The highest incidence rate for the study period was registered in 2014 and the lowest in 2020 with 363.96 and 95.8 per 100,000 population, respectively (Figure 2). In 2020, 17,520 cases of chickenpox were registered in the country, with an incidence rate of 95.8 per 100,000 population (against 41,841 cases with an indicator of 228.9 in 2019) (Figure 1 A).

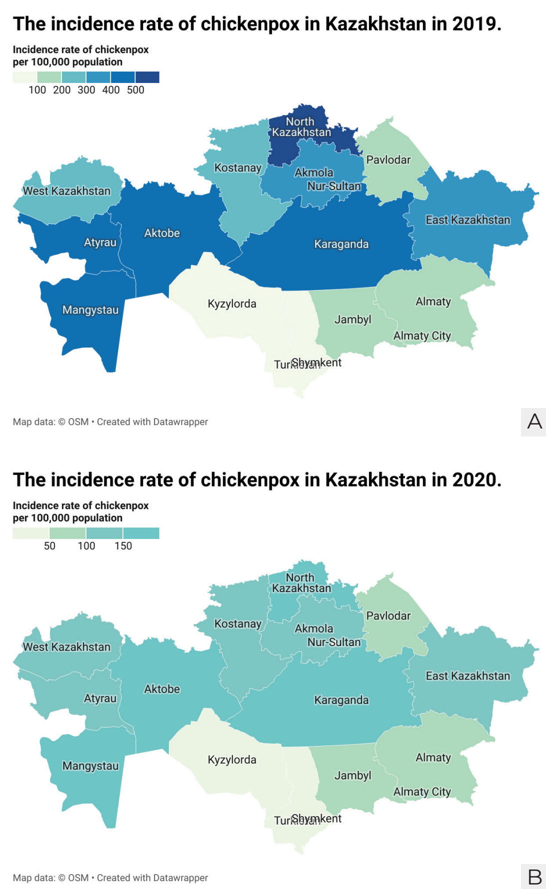

Figure 1 - The incidence rate of chickenpox in Kazakhstan in 2019 (A) and 2020 (B).

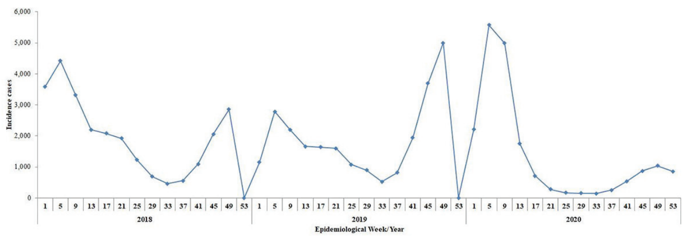

Figure 2 - Incidence of chickenpox (№ of cases) by epidemiological week and year.

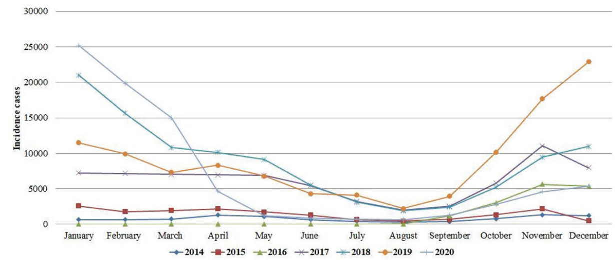

Figure 3 - Incidence cases of chickenpox by year.

Exceeding numbers (or higher than expected numbers) were noted in Akmola (133.8), Aktobe (191.0), Atyrau (132.3), East Kazakhstan (106.2), West Kazakhstan (130.4), Karaganda (177.9), Kostanay (127.9), Mangystau (168.2), North Kazakhstan (176.07) regions and Nur-Sultan (103.4) in 2020 (Figure 1 B). Morbidity was primarily observed during the autumn-winter season showing a similar pattern to previous years with the highest morbidity registration in the winter periods (Figure 3).

According to the National infectious disease monitoring report the age structure of incidence, the highest proportion of cases is observed among children from 4 to 6 years old (29%), children from 1 to 3 years old (24%) and from 7 to 9 years old (15%). As the contingents of patients infected with chickenpox, children attending preschool organizations are more often affected - 37.6%, schoolchildren - 29.9% and unorganized children - 18.8% [17].

Discussion

Our research determined the basic epidemiological characteristics of the primary varicella virus in the country, with mapping of the spreadingand correlation with climate. The seasonality of varicella and the correlation of temperature with varicella had been a topic of many investigations. A number of studies showed a strong seasonality of varicella in temperate climates and in most tropical environments with a peak incidence around winter and spring [16, 18], which is comparable to other respiratory infectious disorders. Our study confirmed the incidence spreadingin cold months. We also observed two incidence peaks: one during the winter months and another from March to May. This could be due to prolonged winters lasting from November to April in northern parts of the country, which is supported by the higher spreading of cases in central and northern Kazakhstan. And more importantly, this may be due to the fact that the youngsters congregate in schools and kindergartens, as well as epidemiological aspects of varicella. The congregation of children in schools and kindergartens undoubtedly increases the spread of VZV in these groups, making them the main susceptible population for varicella. The seasonal trend for cases among non-student adults, preschool children, and infants was not so apparent in previous studies [19]. The reasons for the seasonal incidence differences may relate to properties of VZV, climate models, geographical locations, population density, risk of exposure [20], and other potential factors [21].

We report an incidence range of 95,8 to 363.96 per 100,000 population over a six-year period. The reported incidence of primary varicella in Kazakhstan is substantially lower in comparison to the reported annual incidence in European countries prior to the implementation of universal varicella vaccination [22]. Such low numbers could be due to low-level reportability deu to self-limiting course of illness, low level of detection due to serologic limitations, or may actually represent the true incidence of primary chickenpox cases in the country. Unfortunately, without information on the clinical severity and mortality associated with the reported cases, our understanding of the varicella burden in the country is limited. Therefore, the need for universal vaccination in Kazakhstan is still unclear.

It should be mentioned that the incidence of all respiratory illnesses was lowest in 2020, due to broad preventative measures implemented to battle the novel coronavirus infection COVID-19, which had a significant influence on lowering the incidence of airborne-transmitted respiratory infections in general. At the same time, we must not forget that understanding the potential influencing factors is the foundation for developing preventive and control strategies.

There are a few limitations that should be highlighted. Firstly, due to the use of official statistics alone, our data lack information on the demographic information, and clinical course of the disease, including complications and mortality. Secondly, there is a probable underestimation of cases due to underreporting in young children with mild and self-limited clinical cases. Thirdly, we did not correlate with humidity, air pressure, wind speed, or precipitation, because these measurements were not available.

Conclusion

In summary, the current study assessed the incidence and patterns of the seasonality of chickenpox infection in Kazakhstan in the absence of universal varicella immunization for the period of 2014-2020. The highest incidence rate was registered in 2014 (363.96 per 100,000 population) and morbidity was distributed in the autumn-winter season. These findings might aid in forecasting future outbreaks of infection based on the influence of climate change on chickenpox, and may help in making a decision about the implementation of varicella preventive and control initiatives in the country.

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