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LYME DISEASE IN UKRAINE IN 2000–2023

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ABSTRACT

BACKGROUND. Lyme disease (LD) is the most common tick-borne zoonotic infection in Europe and North America, caused by *Borrelia* spp., primarily transmitted through the bite of infected *Ixodes* ticks. The disease has become a significant public health concern in Ukraine, with the number of reported cases steadily increasing since the initiation of official registration in 2000. Despite this trend, the epidemiological characteristics of LD in Ukraine, particularly its geographic distribution and the influence of socio-political events on its incidence, remain underexplored.

OBJECTIVE. The study aimed to investigate the incidence of LD in Ukraine from 2000 to 2023.

MATERIAL AND METHODS. The study utilized official statistical data of registered LD cases in Ukraine from the Ministry of Health of Ukraine and relevant literature sources.

RESULTS. Over the 23-year period (2000–2023), a total of 45,371 cases of Lyme disease (LD) were recorded in Ukraine, with an annual average of 1,890 ± 1,662 cases. A significant increase was observed in 2015, with an additional rise in 2022, both likely linked to socio-political events such as the reorganization of health services and the war-related population displacement. The highest incidence was recorded in 2023, at 14.08 cases per 100,000 population. Geographic analysis revealed that Kyiv and the Kyiv region had the highest incidence rates, with urban areas being disproportionately affected. Notably, 83.2% of the cases were recorded among urban residents, reflecting a clear urban-rural disparity.

CONCLUSIONS. The incidence of Lyme disease in Ukraine has significantly increased over the past 23 years, particularly in urban areas. The peaks in 2015 and 2022 suggest potential links to socio-political disruptions, such as changes in health services and population displacement due to the war. These findings underscore the need for improved public health strategies, with a particular emphasis on managing LD in urban settings and addressing the urban-rural disparity in case distribution.

Keywords: *Lyme disease, Ukraine, incidence, Ixodes ticks, geographic distribution*

INTRODUCTION

Lyme disease (LD), also known as Lyme borreliosis, is the most common zoonotic infection in Europe and the United States. It is caused by *Borrelia* spp., mostly *B. afzelii*, *B. burgdorferi*, *B garinii* in Europe, transmitted through infected ticks, mainly *Ixodes* spp (1,2). The number of cases of LD has increased steadily, more than 360,000 cases having been reported over the last several decades, with the greatest number of cases in the countries of Central Europe (Czech Republic, Estonia, Lithuania and Slovenia) (3). Geographically, the number of LD cases correlates with the range of *Ixodes* spp. ticks and may vary within the same country (4). In Ukraine, the registration of LD began in 2000, and every year the number of officially registered cases increases on average, but still remains lower than in neighboring country Poland (5). The impact of the COVID-19 pandemic and the 2022 war on the incidence of LD also remains a less researched aspect.

OBJECTIVE

To study the epidemiological situation of LD in Ukraine between 2000 and 2023 based on officially registered cases.

MATERIAL AND METHODS

Statistical information from the "Reports on Individual Infections and Parasitic Diseases" of the regional "Laboratory Centers of the Ministry of Health of Ukraine," as well as summary statistics in Ukraine on LD, for the last 15 years of observations (2009-2023 years). “Reports on Individual Infections and Parasitic Diseases*”* are prepared on the basis of medical documentation Form No. 058/o, approved by the Ministry of Health of Ukraine. This form is completed by the attending physician in cases of clinical suspicion of LD, regardless of whether laboratory confirmation is available at the time. Ukrainian legislation mandates that all physicians complete Form 058/o whenever LD is suspected. If the diagnosis changes, for example, after laboratory test results, a clarifying form may be completed. However, statistical data on the frequency and causes of diagnostic discrepancies are unavailable, as there is no centralized record of positive laboratory results; this information remains only at the local level within hospitals or laboratories. All data was kindly provided by the State Institution "Public Health Center of the Ministry of Health of Ukraine" for scientific purposes.

Data for the period 2000-2008 were used in accordance with the manuscript by Andreychyn et al. (5). A limitation of the statistical data for the period 2000-2009 is the lack of distribution by regions (oblasts), age, and urban-rural areas.

The study materials were statistically processed using parametric and non-parametric analysis methods. The accumulation, systematization of information, analysis, and visualization of the results were carried out using Microsoft Office Excel 2016. The quantitative indicators, whose distribution differed from the normal, were described using median (Me) and lower and upper quartiles [Q1-Q3].

The data on population numbers and territorial structure for the period 2000-2021 were obtained from official sources of the State Statistics Service of Ukraine (6). The population for 2022-2023 was recalculated according to estimates by the United Nations High Commissioner for Refugees (UNHCR) on the number of people relocated abroad (7).

RESULTS

Between 2000 and 2023, a total of 45,371 cases were recorded in Ukraine, with an average of 1,890±1,662 cases per year. The number of cases per year varied from 58 in 2000 to 5,418 in 2018. In the last year of observation (2023), 4,911 cases were registered (Figure 1). In 2015, an increase in the number of cases by 1,789 (by 110%) was noted compared to 2014. The upward trend continued until 2018. On average, 3,886±1,133 cases were registered annually between 2015 and 2018, more than twice as many as in the period 2009-2014, when 1,509±333 cases were registered. In the period 2019-2021, a decrease in LD cases was recorded, followed by an increase in 2022-2023.

The incidence per year also varied, eventually increasing from 0.12 cases per 100,000 population in 2000 to 14.08 in 2023, as shown in Figure 2. On average, Ukraine observed 4.59 cases per 100,000 population.

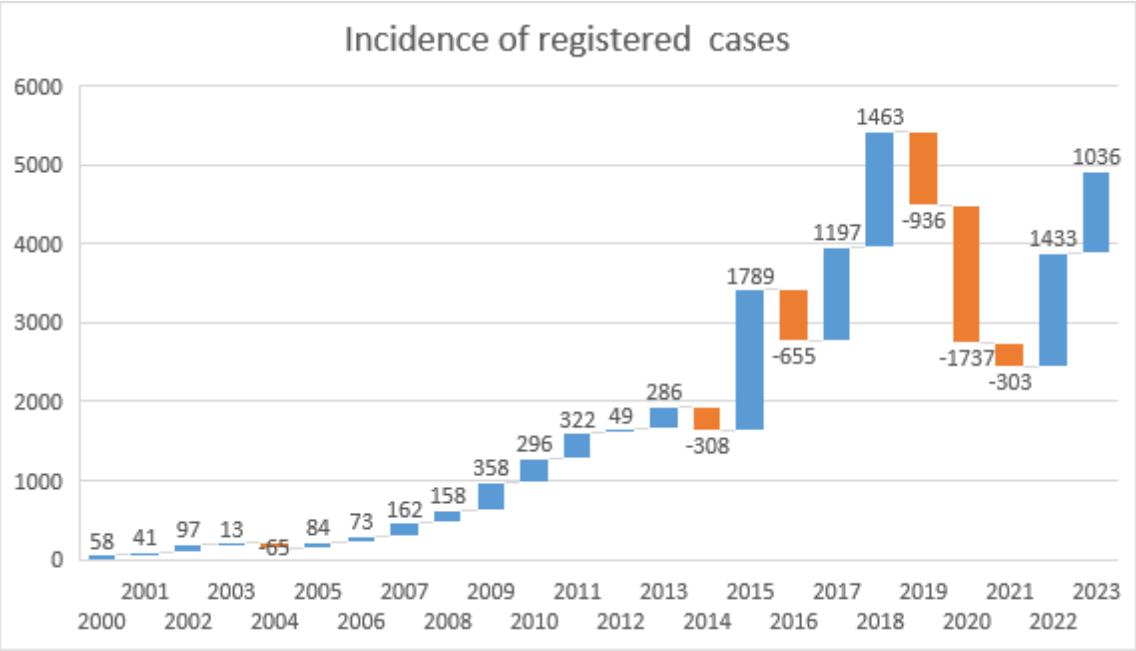

Figure 1. Incidence of registered LD in Ukraine for the period 2000-2023 in Ukraine in absolute numbers. The blue column shows the increase in the number compared to the previous year, the orange column shows the decrease in the number of cases compared to the previous year.

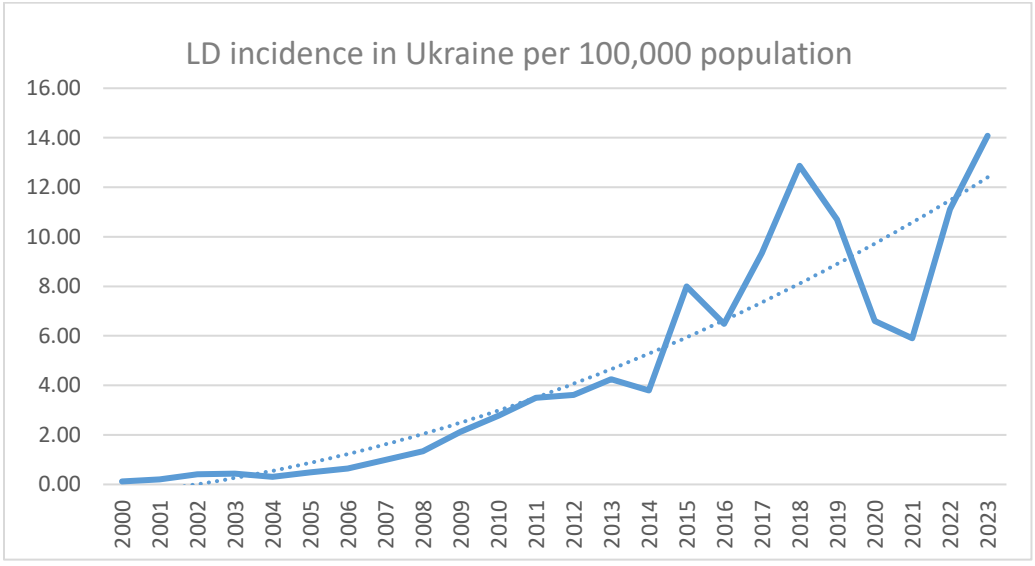

Figure 2. Incidence of registered LD cases in Ukraine in 2000-2023 per 100,000 population. The solid line is the incident, the dotted line is the trend line.

The geographic distribution of the incidence cases varied across different regions of Ukraine, with the highest levels observed in Kyiv (n= 7,573; average per year 505±207.1) and the Kyiv region (n=4,137; Me=270; [109.5; 449.5]), in Cherkasy (n=3,255; Me=173; [120; 307]), Vinnytsia (n=2,718; Me=125; [84; 227.5]), Lviv (n=2,664; Me=150; [113.5; 246.5]), and Dnipropetrovsk regions (n=2,549; Me=129; [94; 253.5]) (Figure 3). These five regions and the city of Kyiv account for 53.2% of all cases. The incidence across regions varied during the observation period. Until 2013, Donetsk region held the second position in incidence rates (after the city of Kyiv). In 2023, Poltava region ranked third in the number of cases, accounting for 10.1% of cases (n=497), following the city of Kyiv and Kyiv region. This is a significant increase from 2009, when it accounted for only 2.1%. In Ivano-Frankivsk region, n=754; Me=34; [25; 60.5], and in Ternopil region n=1,793; Me=107; [60.5; 164.5].

Figure 3. Distribution all reported cases (absolute numbers) of LD in Ukraine, by region, in the time period 2009-2023. Slo. – Slovakia, Hun. – Hungary.

Among all recorded cases, an average of 11.3±1.7% were children (0-17 years). The age structure dynamics are shown in Figure 4. The highest incidence among children was observed in

Kyiv (n=646; Me=44; [29.5; 53.5]), Vinnytsia (n=477; Me=31; [10.5; 48.5]), Kyiv region (n=436; Me=34; [13; 48]), Cherkasy (n=366; Me=24; [16; 33]), Ternopil (n=320; Me=20; [9; 31]) and Kharkiv regions (n=299; Me=16; [11; 25.5]).

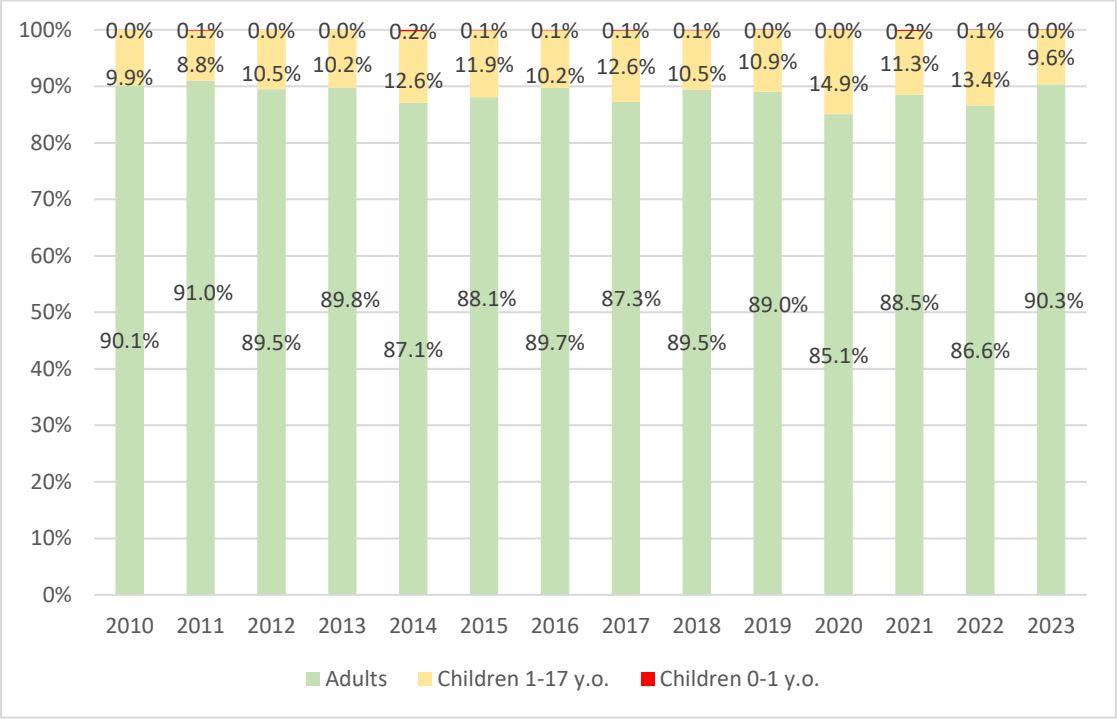

Figure 4. The age structure of registered cases of all reported cases of LD in Ukraine, in the time period 2010-2023.

Among all cases, 83.2% (n=35,815) were recorded in urban residents, while 16.8% (n=7,237) were recorded in rural residents (Figure 5).

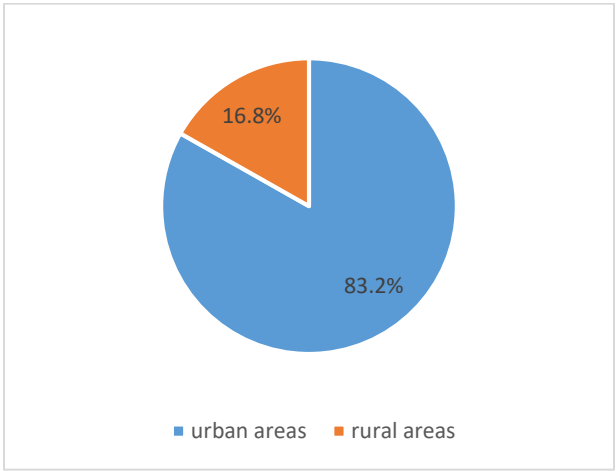

Figure 5. The structure of registered cases of all reported cases of LD in Ukraine, by localities, in the time period 2010-2023.

DISCUSSION

In our study, we analyzed officially registered data on LD cases in Ukraine during 2000-2023, including by age and geographic structure for the period 2010-2023. The number of registered LD cases in Ukraine increased over the period 2000-2023, with a few exceptions. The increase in cases in the early 2000s can primarily be attributed to improved diagnostic methods, as noted in order No. 218 of the Ministry of Health of Ukraine dated May 16, 2005, 'On Strengthening Measures for the Diagnosis and Prevention of Ixodid Tick-Borne Borreliosis in Ukraine' (https://zakon.rada.gov.ua/rada/show/v0218282-05#Text). This document specifically mentions the establishment of a scientific-methodological center for the study of Ixodid tick-borne borreliosis, the intensification of public awareness campaigns, the improvement of material and technical resources, and the enhancement of the epidemiological surveillance system.

We assume that the significant increase in incidence after 2015 (Fig.1) may be related to the reorganization of the State Sanitary and Epidemiological Service in September 2014 (https://zakon.rada.gov.ua/laws/show/442-2014-%D0%BF#Text) and its liquidation in March 2017 (https://www.kmu.gov.ua/npas/250003281), one of whose duties was the primary prevention of infectious diseases (https://zakon.rada.gov.ua/laws/show/400/2011#Text).

The rise in cases in 2022-2023 (Fig.1) may be related to Russian aggression, which led to the forced displacement of the population from the southern and eastern regions of Ukraine. Additionally, migratory birds may play a role in the spread of Lyme disease (8,9), although data on the impact of the war on bird migration in Ukraine are unavailable. Military personnel also have a higher risk of contracting Lyme disease (10), but data on the spread of Lyme disease among the military in Ukraine are lacking.

There was also a decrease in incidence in 2020 and 2021, which may be associated with the introduction of quarantine restrictions due to the SARS-CoV-2 infection. Quarantine was declared in Ukraine on March 12, 2020 (11).

In 2022, according to the United Nations High Commissioner for Refugees (UNHCR), 6.5 million people left Ukraine (7), yet the number of registered cases (absolute numbers) continued to increase in 2022-2023 (Fig.1).

The incidence in Ukraine during the period from 2009 to 2023 averaged 7.01 cases per 100,000 population, with the highest incidence observed in 2023, reaching 14.08 cases per 100,000 population. This is significantly lower than in Poland, where the annual incidence was 10-20 times

higher until 2014 (5). However, after 2014, the difference decreased to a fivefold higher incidence in Poland (12-14). On the other hand, the incidence in Ukraine is higher than in Romania, where the incidence was about four times lower during 2010-2016 (15). According to Kulisz et al. 2024, the incidence positively correlates with the mean annual monthly precipitation (mm/month), the share of parks, lawns, and green spaces in residential areas (%), annual minimum monthly temperature (°C), average annual 8-day gross primary productivity (gC/m^2), and the percentage of forested area, and negatively correlates with population density (16). The difference in the number of cases may likely be explained by socio-economic differences in these indicators.

As of 2013, Ukraine's urban population accounted for 68.8% of the total population, while the rural population made up 31.2%. After 2013, there is no publicly available information on the urban/rural population distribution. However, among all reported cases of Lyme disease, 83.2% occurred among urban residents, while 16.8% occurred among rural residents (Fig.5). Thus, despite one-third of Ukraine's population living in rural areas, only one-sixth of Lyme disease cases are associated with rural populations. These data do not align with the trends observed in neighboring countries. For instance, in Romania, 68% of cases occur among urban residents and 32% among rural residents (17), while about 46% of Romania's population lives in rural areas (18).

The incidence of LD can be correlated with the prevalence of ixodid ticks, so the study by Levytska et al. on the prevalence of ixodid ticks in the western region of Ukraine in 2018-2019 showed that the largest number of *D. reticulatus* ticks was found in the Lviv region (from 46 to 119 ticks /1000 m^2). A low and medium density of adult *D. reticulatus* and *I. ricinus* ticks (from 11 to 77 ticks/1000 m^2) was observed in Ivano-Frankivsk region in 2018 (19). This correlates with our results, which demonstrate a significantly higher number of LD cases in Lviv region, compared to Ivano-Frankivsk (Fig. 3).

Another spot study by the same author, Levytska et al. (2021), devoted to ixodid ticks collected from animals and vegetation in five regions of Ukraine, demonstrated a high prevalence of *B. burgdorferi* s.*l.* in *I. ricinus* in all included cities. In particular, in the city of Kyiv, the causative agent of *Borrelia* was not detected in ticks collected from vegetation (flagging grass, shrubs, and bushes), which may indirectly indicate a relatively good efficiency of park disinsection (20). Another study shows a large species diversity of ixodid ticks in the city of Kyiv, including *I. ricinus* (60.5%), *D. reticulatus* (39.4%), and one *Rhipicephalus sanguineus*, which is atypical for this geographical area (21).

The study has several limitations, such as lacking detailed species-specific *Borrelia* data and not distinguishing between laboratory-confirmed and clinically diagnosed cases, which could affect accuracy. There are gaps in data before 2010 for geographic, urban-rural, and age distribution. Additionally, the effects of population displacement, migratory bird patterns, and lack of military-specific data introduce uncertainties in interpreting the rise in Lyme disease cases.

CONCLUSIONS

The incidence of LD in Ukraine increased significantly during the period from 2000 to 2023. The increase in the number of cases in 2015 and 2022 can be attributed to Russian aggression and population displacement. Despite the negative impact of the COVID-19 pandemic, the incidence of LD in Ukraine continues to grow. The epidemiological situation is particularly acute in urban areas, where the majority of cases are recorded.

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