

Original research article

EPIDEMIOLOGY OF HAEMORRHAGIC FEVER WITH RENAL SYNDROME IN THE AUTONOMOUS PROVINCE OF VOJVODINA, SERBIA, 1992–2023

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Received: 20.01.2025.; Accepted: 10.02.2026.

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Abstract

Although Serbia is recognized as endemic for a haemorrhagic fever with renal syndrome, long-term epidemiological data from subnational regions remain limited. This study aimed to describe temporal, spatial, seasonal and demographic patterns of this disease in the Autonomous Province of Vojvodina, northern Serbia, over 32 years (1992-2023), and to assess potential associations between disease occurrence and selected climatic parameters. A retrospective descriptive study was conducted based on routine surveillance data. Annual crude and age- and gender-specific incidence rates were calculated. Geographic clustering was assessed at the district and municipality levels. Correlations between disease incidence and temperature, precipitation, relative humidity and number of rainy days were evaluated using Spearman's rank correlation coefficient. Over the study period, a total of 82 cases were reported (average annual incidence: 0.13/100,000; 95% CI: 0.10-0.16), characterized by sporadic occurrence and substantial interannual variability, with two deaths recorded. The highest annual incidences were recorded in 2012 (0.41/100,000) and 2014 (0.52/100,000). Incidence exhibited marked spatial heterogeneity, with the highest long-term rates in South Bačka and Srem districts, and municipal hotspots (Beočin, Irig, Sremski Karlovci). Males aged 30–39 years experienced the highest incidence

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rate (0.56/100,000), whereas cases were rare among children. A pronounced seasonal peak was observed in June, accounting for 24.4% of all reported cases. No statistically significant associations were found between annual incidence and climatic parameters. Monthly analysis revealed a positive correlation between number of cases and temperature ($\rho = 0.606$, $p = 0.037$) and a negative correlation with relative humidity ($\rho = -0.621$, $p = 0.031$). Our findings indicate that haemorrhagic fever with renal syndrome remains a low-incidence but endemic zoonosis in AP Vojvodina, characterised by distinct geographic hotspots, well-defined demographic patterns, and stable early-summer seasonality. Enhanced integrated surveillance, improved diagnostic coverage and integration of ecological and environmental data are needed to better understand localized risk and support timely public health interventions.

Key words: Hantavirus, zoonoses, epidemiology, morbidity, geographical distribution, rodents, climatic factors; seasons

INTRODUCTION

Hantaviruses are important rodent-borne pathogens that cause haemorrhagic fever with renal syndrome (HFRS) in Europe and Asia, and hantavirus cardiopulmonary syndrome in the Americas (Kruger et al., 2015; Avšič-Županc et al., 2019). Human infection typically occurs through inhalation of aerosolised rodent excreta, most commonly from species belonging to the Murinae or Arvicolinae subfamilies (Kruger et al., 2015; Avšič-Županc et al., 2019; Lupuşoru et al., 2023). European HFRS is predominantly caused by *Puumala orthohantavirus* (PUUV) and *Dobrava–Belgrade orthohantavirus* (DOBV), which differ in virulence, epidemiology, and rodent reservoirs: PUUV is associated with *Myodes glareolus* and typically causes nephropathia epidemica, a mild form of HFRS, whereas DOBV—carried by several *Apodemus* species—can result in more severe disease and higher case fatality rates (Heyman et al., 2007; Klempa, 2009; Khalil et al., 2019).

Within Europe, HFRS exhibits marked spatial and temporal variations driven by rodent population dynamics, seasonal patterns, and climatic factors that influence rodent abundance and human exposure (Rose et al., 2003; Vapalahti et al., 2003; Linard et al., 2007). Endemic circulation and periodic peaks have been reported in Finland, Sweden, Germany, Belgium, Slovenia, and other countries of central and south-eastern Europe (Klempa, 2009; Avšič Županc et al., 2014; Douglas et al., 2021). Climatic fluctuations, particularly in temperature and precipitation, are recognised as important ecological drivers modulating rodent population cycles and subsequent viral transmission to humans (Klempa, 2009; Avšič Županc et al., 2014; Stamenković et al., 2015; Douglas et al., 2021).

The Republic of Serbia (Serbia) is part of the Balkan hantavirus endemic zone, with confirmed circulation of PUUV and multiple DOBV lineages in both rodent hosts and human populations. Previous national studies have reported sporadic

cases and occasional outbreaks, predominantly in forested, agricultural, and peri-urban regions of northern Serbia (Papa et al., 2006; Stanojevic et al., 2019; Štrbac et al., 2022).

This study provides a 32-year (1992–2023) epidemiological assessment of HFRS in the Autonomous Province (AP) of Vojvodina, examining temporal trends, geographic heterogeneity, age- and gender-specific patterns, seasonal distribution, and associations between HFRS incidence and meteorological variables.

MATERIAL AND METHODS

Study design and setting

A retrospective, population-based epidemiological study on all HFRS cases reported in the AP of Vojvodina, Serbia, from 1 January 1992 to 31 December 2023 was conducted. AP of Vojvodina is located in northern Serbia and consists of seven administrative districts and 45 municipalities, with an estimated population of approximately 1.8 million in 2022 (RZS, 2025).

Data sources and case definitions

Data on HFRS cases were obtained from official surveillance records of the Institute of Public Health of Vojvodina (IPHV), the regional reference institution for communicable disease surveillance. Case notification forms were collected at local public health departments and subsequently forwarded to the IPHV.

Case definitions followed national reporting standards (Štrbac et al., 2022) and were aligned with the World Health Organization (WHO) criteria for hantavirus infections (WHO, 2025). A confirmed case was defined as a reported HFRS case with laboratory evidence of hantavirus infection demonstrated by one or more of the following: detection of hantavirus-specific IgM antibodies; a fourfold or greater increase in IgG antibody titres or hantavirus-specific IgG seroconversion; a positive reverse transcriptase–polymerase chain reaction (RT-PCR) result for hantavirus RNA; positive immunohistochemical detection of hantavirus antigens.

Population denominators for calculating incidence rates were obtained from the Statistical Office of the Republic of Serbia based on census years (1991, 2002, 2011, 2022) (RZS, 2025).

Variables and analytical approach

Extracted variables included the year and month of diagnosis, district and municipality of residence, age, gender, and outcome (survival or death). Average gender- and age-specific incidence rates were calculated based on 8 age groups (0–

4, 5–9, 10–19, 20–29, 30–39, 40–49, 50–59, ≥ 60 years). In addition, spatial analyses included district- and municipality-level annual average incidence rates over the 32-year study period.

Meteorological data

Monthly and annual meteorological parameters (the average temperature in °C, average rainfall in mm, average relative humidity in %, and average number of rainy days ≥ 0.1 mm) were obtained from the Meteorological Service of the Republic Hydrometeorological Institute of Serbia (RHMZ, 2025). Data were matched to case months and aggregated for the study period.

Statistical analysis

Descriptive statistics were used to summarise incidence, demographic characteristics, temporal trends, and spatial distribution. The average incidence rate and its 95% confidence interval were calculated assuming a Poisson distribution of case counts, with person-years at risk as the denominator.

Spearman correlation coefficients (ρ) were used to assess associations between monthly HFRS case counts and climatic parameters. Statistical significance was defined as $p < 0.05$ (two-tailed).

All statistical analyses were conducted using IBM SPSS Statistics software, version 21 (IBM Corp., Armonk, NY, USA). A spatial distribution map was created using QGIS (version 3.42.1).

Ethics statement

The data from this retrospective study are based on the results of HFRS surveillance conducted between 1992 and 2023 as part of the routine surveillance at the Center for Disease Control and Prevention IPHV ; therefore, approval from the Ethics Committee was not required. All analyses were conducted using anonymized and aggregated surveillance data.

RESULTS

Figure 1 summarizes the reported cases, incidence rates, and mortality of HFRS in AP of Vojvodina from 1992 to 2023. Over these 32 years, 82 cases were registered, corresponding to an overall average annual incidence rate of 0.13 per 100,000 population (95% CI: 0.10–0.16).

Case occurrence was sporadic, with most years reporting between 0 and 8 cases. The highest annual counts and incidence rates were recorded in 2012 (8

cases; 0.41/100,000) and 2014 (10 cases; 0.52/100,000), followed by 2023 (7 cases; 0.40/100,000). Several years—particularly between 2019 and 2022—reported zero cases, indicating periods of minimal or absent detected transmission.

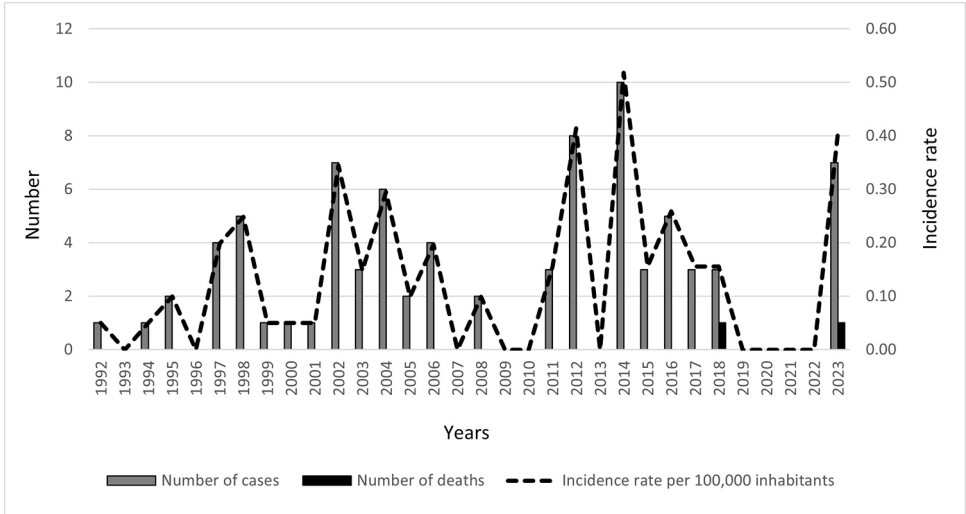


Figure 1. Reported Cases, Incidence Rates per 100,000 population, and Deaths from Haemorrhagic Fever with Renal Syndrome in AP of Vojvodina, 1992–2023.

Throughout the study period, HFRS-associated mortality remained very low, with only two deaths documented: one in 2018 and one in 2023. The latter occurred in a patient who had stayed in a neighboring country during the maximum incubation period, following rodent exposure while camping.

The average incidence rate (between 1992 and 2023) of HFRS in AP of Vojvodina shows pronounced geographical variability across administrative districts. The highest average incidence was recorded in South Bačka (0.27 per 100,000 population, 95% CI: 0.14–0.39), followed by Srem (0.22 per 100,000, 95% CI: 0.12–0.31). Moderate incidence levels were observed in Central Banat (0.06 per 100,000, 95% CI: 0.00–0.12) and South Banat (0.05 per 100,000, 95% CI: -0.01–0.10). By contrast, considerably lower rates were documented in North Bačka (0.02 per 100,000, 95% CI: -0.02–0.06) and West Bačka (0.01 per 100,000, 95% CI: -0.02–0.04). North Banat reported no registered cases during the observed period (Figure 2).

The average incidence of HFRS across municipalities of AP of Vojvodina during the period 1992–2023 showed pronounced spatial heterogeneity. Among municipalities with reported incidence, Beočin (1.99/100,000, 95% CI: 0.63–3.36) and Irig (1.34/100,000, 95% CI: -0.02–2.70) demonstrated the highest long-term average rates, indicating localized areas of increased epidemiological activity. Elevated averages were also recorded in Sremski Karlovci (0.69/100,000, 95% CI: -0.29–1.67), Šid (0.58/100,000, 95% CI: 0.06–1.10), and Temerin (0.46/100,000, 95% CI: -0.10–1.02).

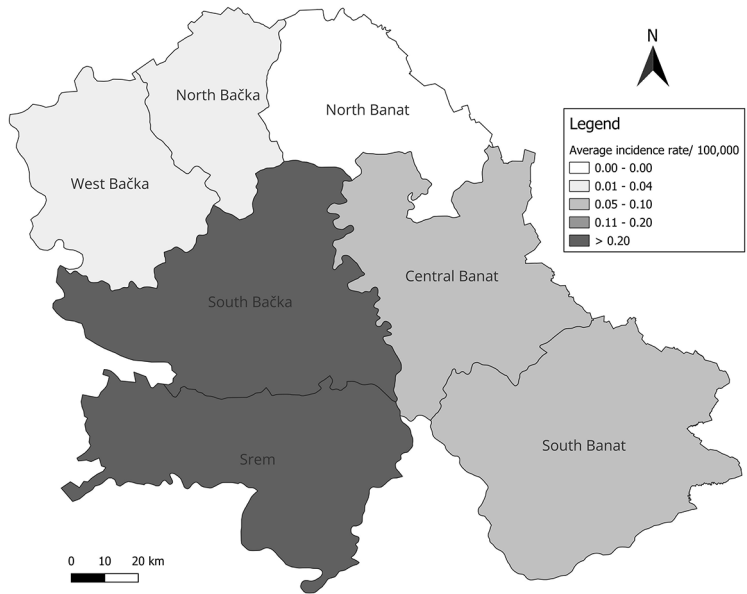


Figure 2. Average Incidence Rate of Haemorrhagic Fever with Renal Syndrome per 100,000 population by District in AP of Vojvodina, 1992–2023.

The City of Novi Sad, the largest urban center in AP of Vojvodina, recorded a long-term average incidence of 0.22/100,000 (95% CI: 0.11–0.33), reflecting sporadic but continuous case occurrence over the three-decade period (Figure 3).

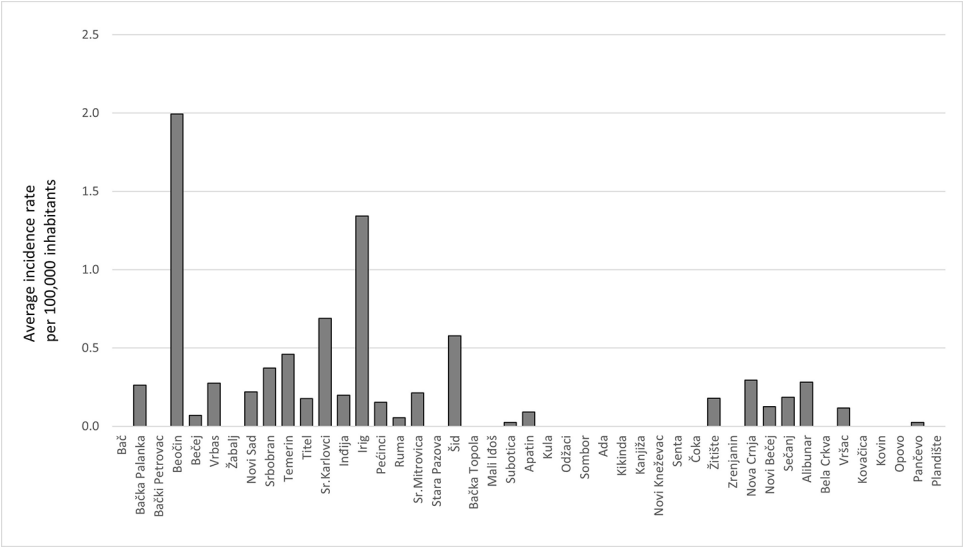


Figure 3. Average Incidence Rate of Haemorrhagic Fever with Renal Syndrome per 100,000 population by Municipality in AP of Vojvodina, 1992–2023.

The analysis of age- and gender-specific average incidence rates of HFRS in AP of Vojvodina in the period 1992–2023 demonstrates clear demographic differences in disease occurrence. Males consistently exhibited higher incidence rates across nearly all age groups, indicating a strong sex-related pattern in HFRS epidemiology.

Among males, the incidence increased from adolescence and peaked in the 30–39 age group (0.56 per 100,000), followed by moderately elevated rates in the 20–29 (0.49) and 40–49 (0.24) age groups. Incidence declined after the age of 50. No cases were recorded in boys aged 0–9 years.

In females, the incidence rates were substantially lower across all age categories. The highest values were observed in the 20–29 age group (0.08), followed by the 50–59 (0.06), and 30–39 (0.05) age groups, whereas most others age groups showed minimal or no recorded incidence. Notably, the 5–9 age group (0.07) was the only childhood group with measurable incidence in females (Figure 4).

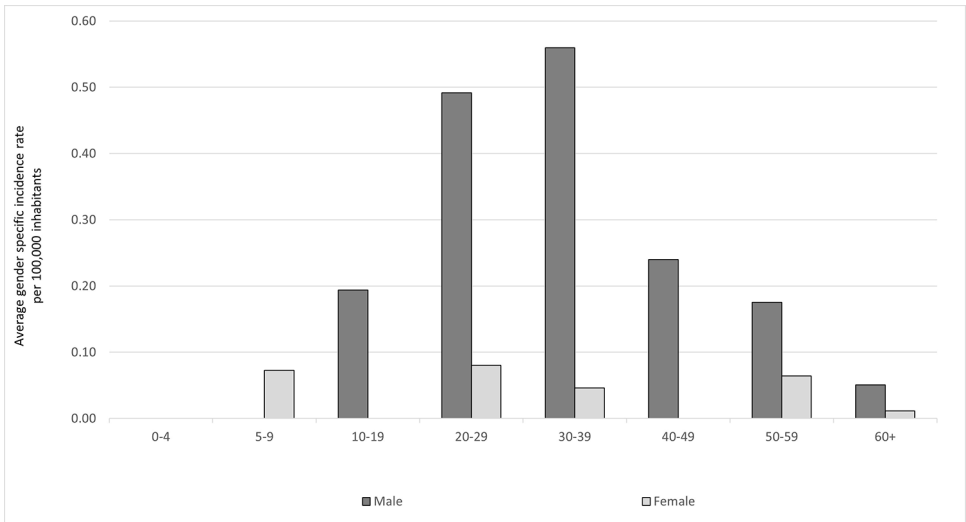


Figure 4. Average Age- and Gender-Specific Incidence Rate of Haemorrhagic Fever with Renal Syndrome per 100,000 population in AP of Vojvodina, 1992–2023.

The monthly distribution of HFRS cases in AP of Vojvodina from 1992 to 2023 demonstrates a clear seasonal pattern, with cases recorded throughout the year but markedly concentrated in late spring and early summer. The highest proportion of cases occurred in June (24.39%), representing the primary seasonal peak. A secondary elevation was observed in April and July (each 13.41%), followed by May and October (each 8.54%), as well as August and November (each 7.32%) (Figure 5).

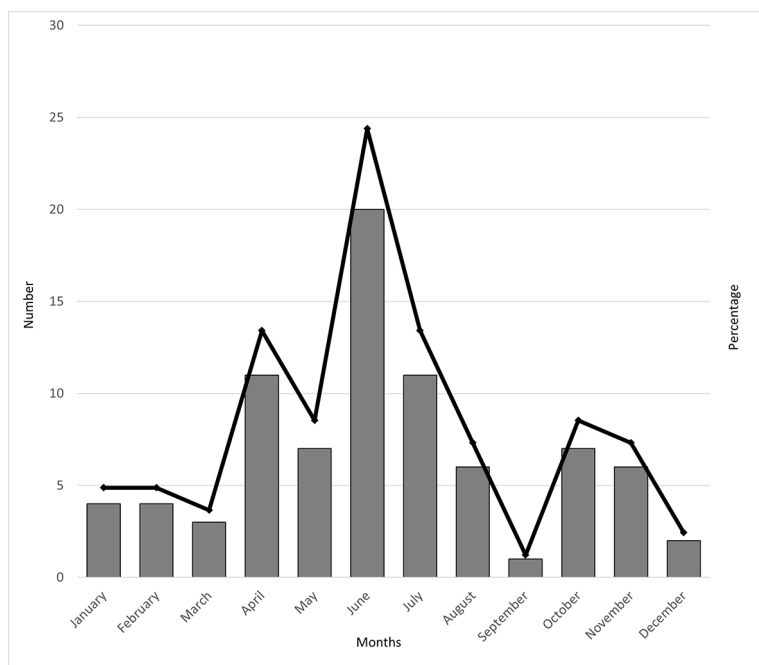


Figure 5. Monthly Distribution of Haemorrhagic Fever with Renal Syndrome Cases in AP of Vojvodina, 1992–2023.

The long-term annual dataset for AP of Vojvodina (1992–2023) illustrates considerable interannual variability in the incidence of HFRS and its potential association with key meteorological parameters. The annual HFRS incidence rate fluctuated between 0 and 0.52 per 100,000 inhabitants. Many years have recorded no cases, indicating low but episodic transmission patterns.

Average annual temperature in AP of Vojvodina ranged from 10.5 to 13.6 °C, demonstrating a gradual warming trend toward the end of the study period. Precipitation levels showed substantial variability, with annual averages spanning 24.4 mm (2000) to 75.7 mm (2010). Relative humidity remained relatively stable over the period, typically between 66% and 78%, with the highest values generally coinciding with wetter years.

The average number of rainy days (defined as days with precipitation ≥ 0.1 mm) varied moderately, ranging from 8 to 12 days per year, with no clear long-term trend but notable interannual differences consistent with precipitation variability (Figure 6). There was no statistically significant association between the incidence rate of HFRS and any of the four observed climatic parameters ($p > 0.05$).

Table 1 presents the monthly distribution of HFRS cases in AP of Vojvodina over the period 1992–2023, alongside key climatic variables, including average temperature (°C), average rainfall (mm), average relative humidity (%), and the average number of rainy days with precipitation ≥ 0.1 mm.

Correlation analysis revealed a statistically significant positive correlation between the number of HFRS cases and average temperature ($\rho = 0.606$, $p = 0.037$), suggesting higher incidence during warmer months. By contrast, a significant negative correlation was observed with average relative humidity ($\rho = -0.621$, $p = 0.031$), indicating lower case numbers during periods of higher humidity. No significant associations were found between HFRS incidence and either average rainfall ($\rho = 0.479$, $p = 0.115$) or the average number of rainy days ($\rho = 0.423$, $p = 0.171$).

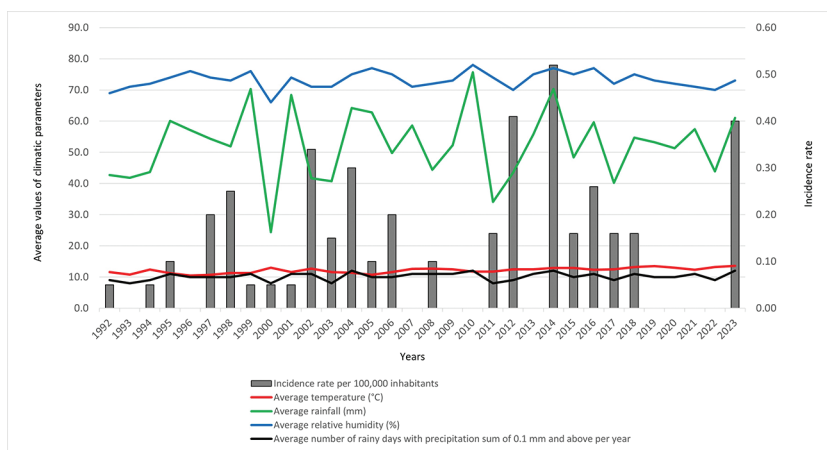


Figure 6. Annual incidence rates of Haemorrhagic Fever with Renal Syndrome per 100,000 population in relation to climatic parameters in AP of Vojvodina, 1992–2023.

DISCUSSION

This 32-year analysis provides the most comprehensive assessment to date of HFRS epidemiology in AP of Vojvodina. The annual incidence of HFRS across the European Union/European Economic Area (EU/EEA) for the period 2019–2023 ranged between 0.4 and 1.1 per 100,000 population (ECDC, 2025). Overall incidence of HFRS in AP of Vojvodina during 1992–2023 was low (0.13 per 100,000 population), with pronounced interannual variability and sporadic case occurrence, consistent with patterns reported in other parts of Serbia and neighboring Balkan countries (Papa et al., 2006; Stamenković et al., 2015; Štrbac et al., 2022).

Our results showed that district heterogeneity was substantial. South Bačka and Srem districts demonstrated the highest long-term average incidence, while some districts—for example North Banat—reported no cases. Similar fine-scale spatial clustering has been described in Slovenia, Croatia, and Belgium, where landscape structure, forest cover, agricultural practices, and rodent reservoir abundance shape local HFRS risk (Avsic-Zupanc et al., 1999; Tersago et al., 2009; Cekinović

Table 1. Monthly distribution of Haemorrhagic Fever with Renal Syndrome cases and correlation with climatic parameters in AP of Vojvodina,

Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ρ (rho)	p value
No of cases	4	4	3	11	7	20	11	6	1	7	6	2		
Aver. temp. (°C)	0.8	2.7	6.8	12.4	17.6	21.3	22.9	22.6	17.4	12.2	6.9	2.0	0.60565	0.03688
Aver. rainfall (mm)	39.1	37.0	35.0	45.1	66.6	79.0	65.9	54.5	59.1	49.9	49.1	49.5	0.47889	0.11523
Aver. rel. hum (%)	85.0	78.8	69.3	66.3	66.7	67.8	65.7	66.3	71.7	75.9	81.9	86.2	-0.62082	0.03122
Aver. no of rainy days (precipitation $\Sigma \geq 0.1$ mm / year)	8.7	7.9	9.4	11.7	13.4	12.0	9.5	8.4	10.1	9.8	10.6	10.3	0.42255	0.17118

Values that differ significantly ($p < 0.05$) are marked in bold

Grbeša et al., 2023). The identification of municipalities such as Beočin and Irig as micro-hotspots suggests the presence of favorable ecological niches supporting *Myodes glareolus* or *Apodemus* species, the primary reservoirs of PUUV and DOBV (Olsson et al., 2010; Avšič Županc et al., 2014).

The gender and age distribution observed in AP of Vojvodina is consistent with well-established epidemiological patterns. Higher incidence among males and adults aged 20–39 years has been consistently reported across EU/EEA countries and is commonly attributed to socio-behavioral factors and increased occupational or recreational exposure to rodent habitats (ECDC, 2025). A similar gender- and age-specific pattern has been described in a study of HFRS covering five Western Balkan countries (Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia and Serbia) (Štrbac et al., 2022). Agricultural workers, including tractor drivers, mechanics, field and livestock farmers, as well as forestry workers, are particularly exposed to infection during rural outbreaks (Tkachenko et al., 2025). Low incidence among children is also typical and may reflect reduced exposure or underdiagnosis of mild or subclinical infections (Olsson et al., 2010; ECDC, 2025; Tkachenko et al., 2025).

Seasonality was clearly defined, with a dominant peak in late spring and early summer. During the 2019–2023 period in Europe, HFRS incidence peaked in July and August. A previously published study conducted in five Western Balkan countries similarly reported the highest average incidence during the summer months over a 10-year period (2006–2015) (Štrbac et al., 2022). This seasonal pattern is likely influenced by agricultural activities, rodent population dynamics, and climatic conditions (Papa et al., 2006; Štrbac et al., 2022). Notably, HFRS incidence increased markedly in 2014, coinciding with severe floods that affected several countries in southeastern Europe, including Serbia (Štrbac et al., 2022).

The analysis of climatic variables revealed no significant associations at the annual level; however, monthly data demonstrated a positive correlation between temperature and HFRS incidence and a negative correlation with relative humidity. We are aware that correlations between the number of HFRS cases and climatic variables may be compromised by underreporting; however, our findings are consistent with previous studies suggesting that warmer conditions may enhance rodent activity and human–rodent interactions, while higher humidity may reduce viral aerosol stability (Klempa, 2009). A systematic review screening 434 studies, with the majority conducted in central Europe (Belgium, France and Germany), reported a strong positive association between temperature and HFRS incidence in central Europe, while evidence for northern Europe remains insufficient. Findings related to precipitation were inconsistent across studies (Diaz, 2015). Our analysis did not reveal a statistically significant relationship between the number of cases and average monthly rainfall in AP of Vojvodina during the study period. Interestingly, the highest number of cases was recorded in 2014, a year marked by major floods caused by heavy rainfall. This apparent discrepancy suggests that, although monthly

rainfall alone does not consistently predict HFRS risk, extreme weather events such as floods can lead to rodent overpopulation and alter environmental conditions in a way that increases human exposure to hantavirus. Similar observations have been reported in other countries (Diaz, 2015), where rare and extreme climatic events have been associated with local increases in HFRS cases. Therefore, while our correlation analysis captures long-term trends, it may not fully reflect the impact of episodic climate extremes on disease incidence. Overall, climatic influences on HFRS transmission are complex, often mediated by delayed effects on rodent population dynamics, and may not be fully captured by simple correlation models (Klempa, 2009; Roda Gracia et al., 2015; Tian and Stenseth, 2019).

Mortality from HFRS in AP of Vojvodina remained very low, with only two deaths recorded over the 32-year study period. This finding is consistent with the predominance of PUUV in AP of Vojvodina (Štrbac et al., 2022), which is associated with mild to moderate clinical disease and low case fatality rates across much of the Balkan region (Papa et al., 2006; Stamenković et al, 2015). Nevertheless, occasional importation of severe cases from DOBV-endemic areas, along with sporadic circulation of more virulent DOBV lineages, has been documented in Serbia (Stanojevic et al., 2019), underscoring the need for continued epidemiological surveillance and laboratory characterization.

This study has several strengths, including its long duration, population-based design, and integration of demographic, spatial, and climatic data. However, it also has several limitations that should be considered when interpreting the findings. First, the analysis relied on routine surveillance data collected over more than three decades, during which diagnostic practices and reporting procedures evolved. Second, the surveillance system captures only clinically recognized and laboratory-confirmed cases. Mild, subclinical, or atypical infections are therefore likely underreported, resulting in underestimation of the true population incidence of HFRS. Third, information on key epidemiological variables—such as occupation, rodent exposure, recreational activities, or precise locations of exposure—is not systematically collected. This limits the interpretation of interannual variability and the identification of specific risk factors underlying the higher incidence observed in certain districts (e.g., South Bačka and Srem). In addition, data on circulating hantavirus species (e.g., PUUV versus DOBV) were unavailable, precluding assessment of genotype-specific differences in disease severity or geographic distribution. Integrating molecular typing into routine surveillance systems could substantially enhance the understanding of transmission dynamics and enable more detailed epidemiological analyses. Fourth, environmental and ecological drivers of HFRS transmission could not be comprehensively assessed. Longitudinal data on rodent population dynamics, forest cover, land use change, or agricultural activity were not available, limiting the ability to link incidence trends to ecological fluctuations. Fifth, despite the long observation period, the absolute number of HFRS cases was relatively small in several years, reducing statistical

power for analyses of mortality patterns and long-term trends. Underdiagnosis or misclassification — particularly in earlier years or in rural areas with limited access to laboratory diagnostics — cannot be excluded. Finally, the absence of seroprevalence data in the general population prevents estimation of cumulative exposure and the proportion of inapparent infections. Consequently, interpretation of temporal trends relies solely on clinically detected cases, which may not fully reflect underlying transmission dynamics. Finally, a potential limitation of spatial analyses is that cases are presented according to place of residence, while the actual location of exposure may differ, as illustrated by the imported case observed in this study.

Despite these limitations, the study provides the most comprehensive overview to date of long-term HFRS epidemiology in AP of Vojvodina and identifies important temporal and spatial patterns that are relevant for public health planning and risk mitigation. Overall, the findings indicate endemic but low-intensity circulation of hantaviruses in AP of Vojvodina, with marked spatial clustering and clear demographic and seasonal patterns. Future studies incorporating time-lag models may provide a more accurate assessment of delayed climatic effects on human infection.

CONCLUSION

HFRS remains a rare but endemic zoonotic infection in AP of Vojvodina, characterized by pronounced spatial clustering, distinct demographic differences, and consistent seasonal trends. Although the overall incidence remained low over the three decades studied, distinct hotspots in certain districts, together with the predominance of cases among younger and middle-aged males, suggest ongoing localized transmission linked to specific environmental and behavioral exposures. The consistent seasonal peak in late spring and early summer highlights the role of rodent-related activities and environmental conditions in shaping transmission dynamics.

Despite substantial interannual variability, mortality remained very low. The absence of significant long-term associations between incidence and major climatic parameters at the annual level suggests that ecological and behavioral factors beyond broad meteorological trends more strongly modulate transmission in this setting. However, the significant monthly correlation with temperature and inverse correlation with humidity highlight the value of finer-resolution environmental data for understanding short-term transmission patterns.

These findings emphasize the need to strengthen targeted risk communication in high-incidence districts, enhance early clinical recognition in primary care, and improve diagnostic coverage to reduce under-ascertainment. Integrating epidemiological surveillance with rodent monitoring and environmental data would substantially improve predictive capacity and allow more timely public health

responses. Given the observed geographic heterogeneity, sustained surveillance and periodic risk reassessments remain essential for preventing future outbreaks and mitigating the burden of HFRS in the AP of Vojvodina.

Author's contribution:

MK and MR contributed to the conception and design of the article; MK and TP were involved in data collection; MK and TP drafted the manuscript; MR coordinated the work and revised the manuscript; MK and SM prepared the final draft; MR and TP performed statistical analysis, SM and MŠ contributed to results analysis and the way of results presentation. All authors have read and approved the final manuscript.

Funding

This research received no external funding.

Ethical statement

This study was conducted in accordance with the principles of the Declaration of Helsinki and applicable national regulations. The study was based on routinely collected surveillance data obtained from the Institute of Public Health of Vojvodina. As the study involved secondary analysis of anonymized and aggregated data with no possibility of identifying individual participants, formal ethical approval and informed consent were not required according to national legislation. Data confidentiality and privacy were strictly maintained throughout the study.

Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Acknowledgments

The authors would like to thank all colleagues involved in the surveillance of HFRS in the Autonomous Province of Vojvodina, Serbia.

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EPIDEMIOLOGIJA HEMORAGIJSKE GROZNICE SA BUBREŽNIM SINDROMOM U AUTONOMNOJ POKRAJINI VOJVODINI, SRBIJA, 1992–2023

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Kratak sadržaj

Iako je hemoragijska groznica sa bubrežnim sindromom u Srbiji prisutna endemski, višedecenijski epidemiološki podaci na subnacionalnom nivou su ograničeni. Ova studija je imala za cilj da opiše hronološke, topografske, sezonske i demografske obrasce ove bolesti u Autonomnoj Pokrajini Vojvodini, severna Srbija, tokom perioda od 32 godine (1992–2023), kao i da utvrdi potencijalnu povezanost između pojave ove bolesti i odabranih klimatskih parametara. Sprovedena je retrospektivna deskriptivna studija zasnovana na podacima rutinskog nadzora. Izračunate su godišnje opšte, kao i uzrasno- i polno-specifične stope incidencije. Prostorno grupisanje slučajeva procenjeno je na nivou okruga i opština. Korelacija između incidencije ove bolesti i temperature, količine padavina, relativne vlažnosti vazduha i broja kišnih dana analizirana je korišćenjem *Spearman*-ovog koeficijenta rang-korelacije. Tokom posmatranog perioda prijavljena su ukupno 82 slučaja (prosečna godišnja stopa incidencije: 0,13/100.000; 95% CI: 0,10-0,16) i dva smrtna ishoda. Bolest je registrovana sporadično, uz izraženu godišnju varijabilnost. Najviše stope incidencije zabeležene su 2012. (0,41/100.000) i 2014. godine (0,52/100.000). Prisutna je izrazita topografska heterogenost oboljenja, sa najvišim vrednostima u Južnobačkom i Sremskom okrugu i u nekoliko opština (Beočin, Irig, Sremski Karlovci). Muškarci uzrasta 30–39 godina imali su najvišu stopu incidencije (0,56/100.000), dok su slučajevi bili retki među decom. Izražen sezonski vrhunac obolevanja zabeležen je u junu, kada je registrovano 24,4% svih slučajeva. Nisu utvrđene statistički značajne povezanosti između godišnje incidencije i klimatskih parametara. Međutim, dokazana je pozitivna korelacija između broja slučajeva po mesecima i temperature ($\rho = 0,606$; $p = 0,037$) i negativna korelacija sa relativnom vlažnošću vazduha ($\rho = -0,621$; $p = 0,031$). Naši rezultati ukazuju da je hemoragijska groznica sa bubrežnim sindromom endemski prisutna zoonoza sa niskom incidencijom u AP Vojvodini. Karakterišu je prostorna žarišta, jasno definisani demografski obrasci i stabilna sezonska pojava u ranom letnjem periodu. Pojačan integrisani nadzor, dostupnost dijagnostike i uključivanje ekoloških i klimatskih podataka neophodni su za bolje razumevanje rizika na lokalnom nivou i podršku pravovremenim javnozdravstvenim intervencijama.

Ključne reči: Hantavirus, zoonoze, epidemiologija, morbiditet, geografska distribucija, glodari, klimatski faktori, godišnja doba