DATABASE ANALYSIS

e-ISSN 1643-3750
© Med Sci Monit, 2026; 32: e953354
DOI: 10.12659/MSM.953354

Received: 2026.03.08
Accepted: 2026.05.25
Available online: 2026.07.01
Published: 2026.XX.XX

Trends in Comorbidities and Fatalities Among First-Time Hepatitis B Hospitalizations in Poland (2012-2023)

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ACDE 1 Agnieszka Genowska*
ADE 2 Krystyna Dobrowolska*
ADE 3 Dorota Zarębska-Michaluk
ABCE 4 Jerzy Jaroszewicz
ABCE 5 Krzysztof Kanecki
ABCE 5,6 Katarzyna Lewtak
C 7 Paweł Goryński
ADE 5 Aneta Nitsch-Osuch
ADE 8 Piotr Rzymski
ADE 9 Robert Flisiak

1 Department of Public Health, Medical University of Białystok, Białystok, Poland
2 Collegium Medicum, Jan Kochanowski University, Kielce, Poland
3 Department of Infectious Diseases and Allergology, Jan Kochanowski University, Kielce, Poland
4 Department of Infectious Diseases and Hepatology, Medical University of Silesia, Katowice, Poland
5 Department of Social Medicine and Public Health, Medical University of Warsaw, Warsaw, Poland
6 Department of Population Health Monitoring and Analysis, National Institute of Public Health NIH-National Research Institute, Warsaw, Poland
7 School of Public Health, Centre of Postgraduate Medical Education, Warsaw, Poland
8 Department of Environmental Medicine, Poznań University of Medical Sciences, Poznań, Poland
9 Department of Infectious Diseases and Hepatology, Medical University of Białystok, Białystok, Poland

* Agnieszka Genowska and Krystyna Dobrowolska contributed equally to this manuscript

Corresponding Author: Piotr Rzymski, Poznań University of Medical Sciences, Department of Environmental Medicine, Rokietnicka 10, 62-070 Poznań, Poland, Phone: +48616418590, e-mail: rzymskipiotr@ump.edu.pl

Financial support: None declared
Conflict of interest: None declared

Background: The clinical profile of patients hospitalized with hepatitis B virus (HBV) is increasingly influenced by coexisting conditions and death patterns. This study aimed to assess comorbidities and fatality rates among patients hospitalized for the first time with HBV between 2012 and 2023.

Material/Methods: A 12-year retrospective nationwide analysis of first-time HBV hospitalizations in Poland was conducted using data from the Nationwide General Hospital Morbidity Study.

Results: Digestive diseases (15.6%), cardiovascular diseases (10.5%), and endocrine and metabolic disorders (9.6%) were the most prevalent comorbidities. Between 2012 and 2023, marked increases were observed in digestive (12.3%-27.4%) and metabolic (8.5%-18.5%) disorders, while circulatory diseases rose from 7.4% to 18.6% with post-2019 stabilization. Immune-related and genitourinary disorders demonstrated sustained post-2019 growth, whereas several categories, including neoplasms and respiratory diseases, showed growth-decline patterns. Hypertension and liver fibrosis were the most frequent individual diagnoses, with sustained or stepwise increases over time. Age-stratified analyses revealed a shift from infection-related conditions in younger patients toward cardiometabolic and advanced hepatic diseases in older groups. Fatality rates increased from 6.8-15.9 per 1000 hospitalizations (2012-2019) to 23.1-30.7 per 1000 (2020-2023), peaking during 2020-2021, with higher mortality in men.

Conclusions: First-time HBV hospitalizations are increasingly characterized by multimorbidity and rising fatality rates, particularly in older patients. These findings highlight a growing clinical and public health burden, underscoring the need for integrated, age-tailored management and improved surveillance to reduce mortality and optimize HBV care.

Keywords: Comorbidity • Epidemiology • Fatal Outcome • Hepatitis B • Hospitalization

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/953354

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Introduction

Although the incidence of hepatitis B virus (HBV) infection has markedly declined in many regions following the introduction of universal immunization, HBV continues to impose a significant clinical and public health burden [1]. The World Health Organization estimates that 1.2 million new infections occur yearly, and 250 million people worldwide are chronically infected, with HBV accounting for approximately 1.1 million deaths annually due to cirrhosis, liver failure, and hepatocellular carcinoma [2]. While antiviral therapies represent a major advance in disease management, they remain suboptimal, as they rarely achieve complete viral eradication and typically require long-term treatment [3]. HBV-infected individuals frequently present with multiple comorbidities that can influence clinical outcomes and healthcare utilization. The persistence of chronic infections among individuals born before widespread vaccination, together with the impact of migration and socioeconomic disparities, ensures that HBV remains a relevant cause of morbidity and mortality in both low- and high-income settings [4-6].

HBV epidemiology in Europe is geographically diversified. Western and northern European countries have achieved very low prevalence rates, typically < 1% to 2%, whereas Central, Eastern, and Southern European regions still display intermediate endemicity. Across all regions, HBV prevalence is significantly higher among prisoners, people who inject drugs, and migrants from high-prevalence countries, with prevalence in some of these groups sometimes reaching 7% [7,8]. Vaccination and targeted interventions have reduced the incidence of HBV, but high-risk groups, aging populations, and migration continue to shape the epidemiological landscape [8].

Poland represents a particularly interesting case within the European context. At the end of the 1980s, it was considered a country with medium endemicity (45 per 100 000), but the introduction of universal newborn vaccination between 1994 and 1996 led to a dramatic decrease in HBV infection incidence [9-11]. However, many individuals infected before vaccination remain at risk of chronic liver disease and its complications [12]. Furthermore, the percentage of fully vaccinated children is currently on a steady decline. In 2023, fewer than 90% of 2-year-olds were fully vaccinated against hepatitis B, compared with 2014, when over 95% received the full vaccination course [13]. Despite progress in infection control and blood safety, HBV continues to be diagnosed in hospitals, often among patients admitted for other reasons [14]. Available data indicate that HBV-related hospitalizations still burden the healthcare system, yet available evidence is fragmented [14]. Recent external factors, including migration and the COVID-19 pandemic, may have further influenced HBV epidemiology in Poland. Migration from regions with higher HBV prevalence, including Ukraine, and pandemic-related disruptions to healthcare services could have affected both detection and management, and delayed progress toward the objectives of 2016, a global strategy to eliminate HBV infections by 2030. Poland is currently not on track to meet the World Health Organization (WHO) targets [14-17].

Consequently, the demographic and clinical profile of HBV hospitalizations in Poland needs to be characterized at the national level. Hospitalization data can offer valuable insights into disease burden, temporal trends, and patterns of comorbidity that are often missed by surveillance systems [18-20]. These data can, in turn, support strategies aligned with the WHO's hepatitis elimination goal for 2030 [21] and help policymakers anticipate healthcare needs and refine prevention efforts for high-risk groups.

The present study provides a comprehensive, nationwide assessment of first-time HBV hospitalizations in Poland from 2012 to 2023, based on data from the national hospital discharge registry. It characterizes demographic features, comorbidity patterns, and temporal trends in this population. By capturing longitudinal changes in the clinical profile of hospitalized patients, this study offers novel insights into the evolving burden and complexity of HBV in Poland, thereby informing strategies for improved disease management and supporting efforts toward HBV control and elimination.

Material and Methods

Data Source

This retrospective population-based study utilized data from the Nationwide General Hospital Morbidity Study (NGHMS), conducted by the National Institute of Public Health - National Research Institute (NIPH-NRI) in Poland. The NGHMS is a nationwide administrative hospital discharge registry covering all hospitalizations in Poland, with standardized data collection across all hospitals. For each hospitalization, the NGHMS dataset includes sociodemographic characteristics (sex, age, date of birth, place of residence, dates of hospital admission and discharge, and in-hospital death), as well as information on the principal diagnosis and comorbidities coded according to the International Classification of Diseases, 10th Revision (ICD-10). The data scope and format were strictly standardized at the national level. NGHMS data are also used by international organizations such as the WHO, the Organization for Economic Co-operation and Development (OECD), and Eurostat, via Statistics Poland.

Study Design and Variables

All hospital admissions with reported HBV infection from 2012 to 2023 were analyzed, totaling 80 181 cases. First-time

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

hospital admissions were identified using sociodemographic data (sex, age, date of birth). The analytical dataset included records with ICD-10–coded principal diagnoses, comorbidities, underlying cause of death, dates of admission and discharge, and discharge mode (including in-hospital death). A "first-time hospitalization" was defined as the first recorded hospital admission within the NGHMS dataset during the study period (2012-2023) in which an HBV-related ICD-10 diagnosis was present, either as a principal or secondary diagnosis. Identification was based on patient-level sociodemographic identifiers (sex, date of birth), allowing linkage across hospitalizations within the registry period.

Inclusion criteria included hospitalization with HBV infection recorded as either the principal or a secondary diagnosis (ICD-10 codes related to HBV infection). The exclusion criteria included records with incomplete comorbidity information. Therefore, 100 records were excluded from the final analytical dataset. The final study population included 29 335 first-time HBV hospitalizations.

Patients with a principal diagnosis within the HBV-related ICD-10 diagnoses accounted for 79.3% of all cases. These codes were excluded from the comorbidity analyses because HBV infection was the inclusion criterion. The criteria for selecting disease entities for analysis were their frequency of occurrence and their clinical significance. Comorbidities were categorized according to ICD-10 chapters, including certain infectious and parasitic diseases (A00–B99), chronic hepatitis C virus [HCV] (B18.2), human immunodeficiency virus (HIV) disease (B20-B24), neoplasms (C00, D48), hepatocellular carcinoma (C22), diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50, D89), anemias (D50-D53, D59-D64), purpura and other hemorrhagic conditions (D69), endocrine, nutritional and metabolic diseases (E00, E90), diabetes mellitus (E10-E14), disorders of lipoprotein metabolism and other lipidemias (E78), diseases of the nervous system (G00, G99), diseases of the eye and adnexa, ear, and mastoid process (H00, H95), diseases of the circulatory system (I00, I99), essential (primary) hypertension (I10), diseases of the respiratory system (J00, J99), diseases of the digestive system (K00, K93), gastritis and duodenitis (K29), alcoholic liver disease (K70), hepatic failure, not elsewhere classified (K72), fibrosis and cirrhosis of the liver (K74), other diseases of the liver (K76), cholelithiasis (K80), diseases of the skin and subcutaneous tissue (L00, L99), diseases of the musculoskeletal system and connective tissue (M00, M99), diseases of the genitourinary system (N00, N99), chronic kidney disease (N18), pregnancy, childbirth and the puerperium (O00, O99), congenital malformations, deformations, and chromosomal abnormalities (Q00, Q99), symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (R00, R99), injury, poisoning and certain other consequences of external causes (S00, T98), codes for special purposes (U00, U85), and factors influencing health status and contact with health services (Z00, Z99).

Percentage indicators were calculated as the proportion of individuals in a given year (or across the entire study period) who were diagnosed at least once with a disease in a given group, relative to all hospitalized HBV patients. The fatality rate was defined as the number of in-hospital deaths divided by the total number of hospitalized persons in a given year, expressed per 1000 hospitalizations.

Statistical Analyses

Statistical analyses were performed using Statistica v.13 (StatSoft Inc., Tulsa, OK, USA). The *t*-test was applied for age comparisons, while the chi-square test of independence was used to compare distributions of categorical variables between groups. The coefficient of determination (R^2) was reported for linear models. A two-sided *P*-value < 0.05 was considered statistically significant.

Ethics

The study was conducted in accordance with the Declaration of Helsinki, and its protocol was approved by the Ethics Committee of the Medical University of Białystok (approval number APK-002-149-2024, dated 22 February 2024). The analyzed data were anonymized, and no patient's identity was revealed. Patient consent was waived in the bioethical approval due to the study's retrospective design based on records collected within the NGHMS

Results

The overall distribution of the main comorbidity categories among patients hospitalized for the first time due to HBV infection between 2012 and 2023 is presented in **Figure 1**. Digestive system diseases were the most frequent coexisting conditions, accounting for 15.6% of all recorded comorbidities. Cardiovascular diseases ranked second among the most prevalent categories (I00-I99, 10.5%), followed by endocrine, nutritional, and metabolic disorders (E00-E90, 9.6%). Certain infectious and parasitic diseases (A00-B99) accounted for 6.9% of comorbid diagnoses, while disorders of the blood and immune mechanisms (D50-D89) accounted for 6.7%. Neoplasms (C00-D48, 5.0%) and diseases of the genitourinary system (N00N99, 4.7%) were observed less frequently, while respiratory, musculoskeletal, and neurological diseases accounted for relatively small proportions. Categories with a low prevalence (< 1%) included diseases of the eye, adnexa, and ear; dermatological conditions; pregnancy-related diagnoses; congenital

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

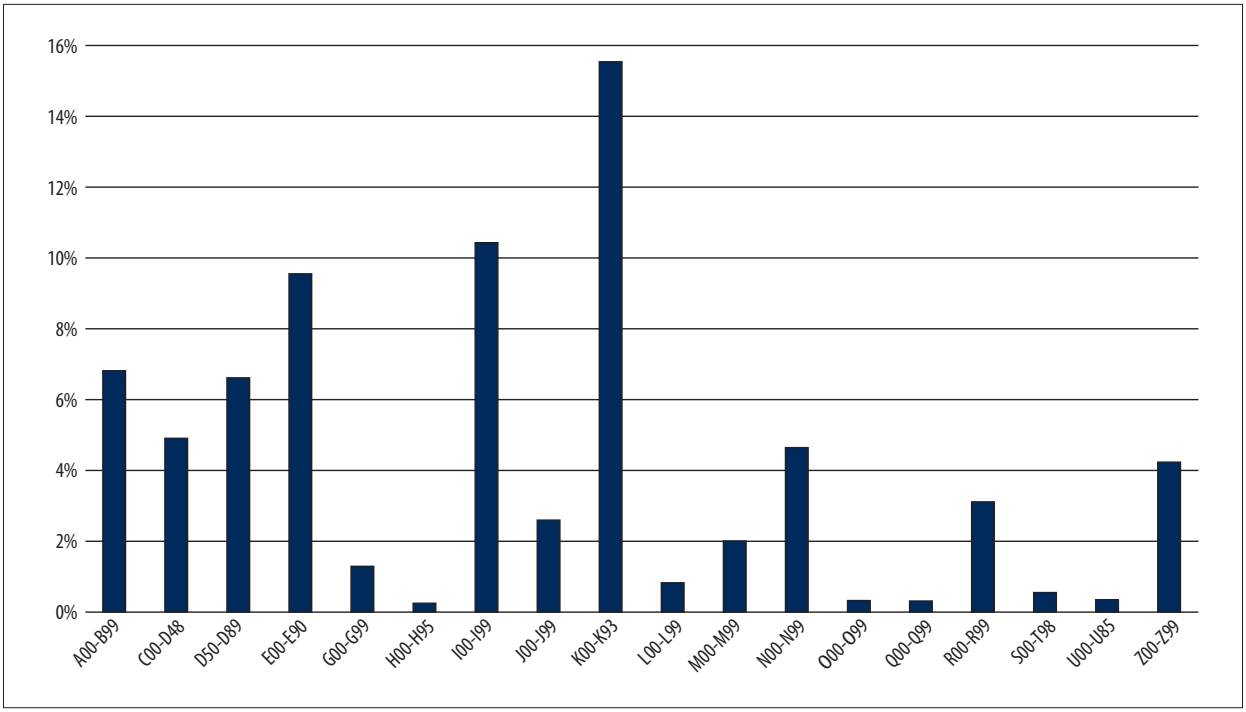

Figure 1. Overall distribution of ICD-10 comorbidity categories among patients hospitalized for the first time due to HBV infection, from 2012 to 2023. For an explanation of ICD-10 codes, please see the Material and Methods section. ICD-10, International Classification of Diseases, 10th Revision; HBV, hepatitis B virus.

malformations; injuries and external causes; and codes for special purposes.

Temporal changes in the percentage distribution of ICD-10 comorbidity categories among patients hospitalized for the first time due to HBV infection are shown in **Figure 2**. After 2019, several distinct trend patterns were observed. A relatively stable post-2019 pattern was noted for certain infectious and parasitic diseases (A00-B99), which fluctuated narrowly between 8.5% in 2019 and 9.1% in 2023, and for diseases of the circulatory system (I00-I99), which increased from 13.0% in 2019 to 18.9% in 2022 and remained comparable in 2023 (18.6%). A sustained upward trend was identified for disorders of the blood and immune system (D50-D89), rising from 7.1% in 2019 to 12.5% in 2023; endocrine, nutritional, and metabolic diseases (E00-E90), increasing from 9.5% in 2019 to 18.5% in 2023; diseases of the skin and subcutaneous tissue (L00-L99), increasing from 1.2% to 2.8%; and diseases of the genitourinary system (N00-N99), increasing from 3.9% to 9.0% over the same period.

A growth-decline pattern (increase followed by partial decrease) was observed for neoplasms (C00-D48), which rose from 4.9% in 2019 to 13.9% in 2022, then decreased to 11.7% in 2023. Similar dynamics were noted for diseases of the eye, adnexa, and ear (H00-H95), increasing from 0.1% in 2019 to 1.1% in 2021 and declining thereafter; diseases of the respiratory system (J00-J99), rising from 2.8% in 2019 to 8.8% in 2021 and decreasing to 5.4% in 2023; and diseases of the digestive system (K00-K93), increasing from 17.9% in 2019 to 29.1% in 2022 before slightly declining to 27.4% in 2023. A comparable rise–fall pattern was also observed for congenital malformations (Q00-Q99), nonspecific symptoms (R00-R99), codes for special purposes (U00-U85), and factors influencing health status (Z00-Z99), the latter increasing from 4.2% in 2019 to 9.6% in 2021 and subsequently decreasing to 7.5% in 2023. A stepwise increase was observed for diseases of the nervous system (G00-G99), rising from 1.6% in 2019 to 2.8% in 2023, and for diseases of the musculoskeletal system and connective tissue (M00-M99), increasing from 2.6% to 5.7% over the same period. In contrast, pregnancy, childbirth, and the puerperium (O00-O99) showed a declining trend after 2020, from 2.3% in 2020 to 1.2% in 2023.

The most frequent individual comorbid diagnoses among patients hospitalized for the first time due to HBV infection are presented in **Figure 3**. Across the entire study period (2012-2023), the leading conditions were essential hypertension (I10; 6.13%), fibrosis and cirrhosis of the liver (K74; 5.36%), purpura and other hemorrhagic conditions (D69; 3.67%), disorders of lipoprotein metabolism (E78; 3.62%), chronic HCV (B18.2; 3.15%), and other liver diseases (K76; 2.92%). A sustained upward trend was observed for essential hypertension (I10), which increased from 4.1% in 2012 to 11.4% in 2023,

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

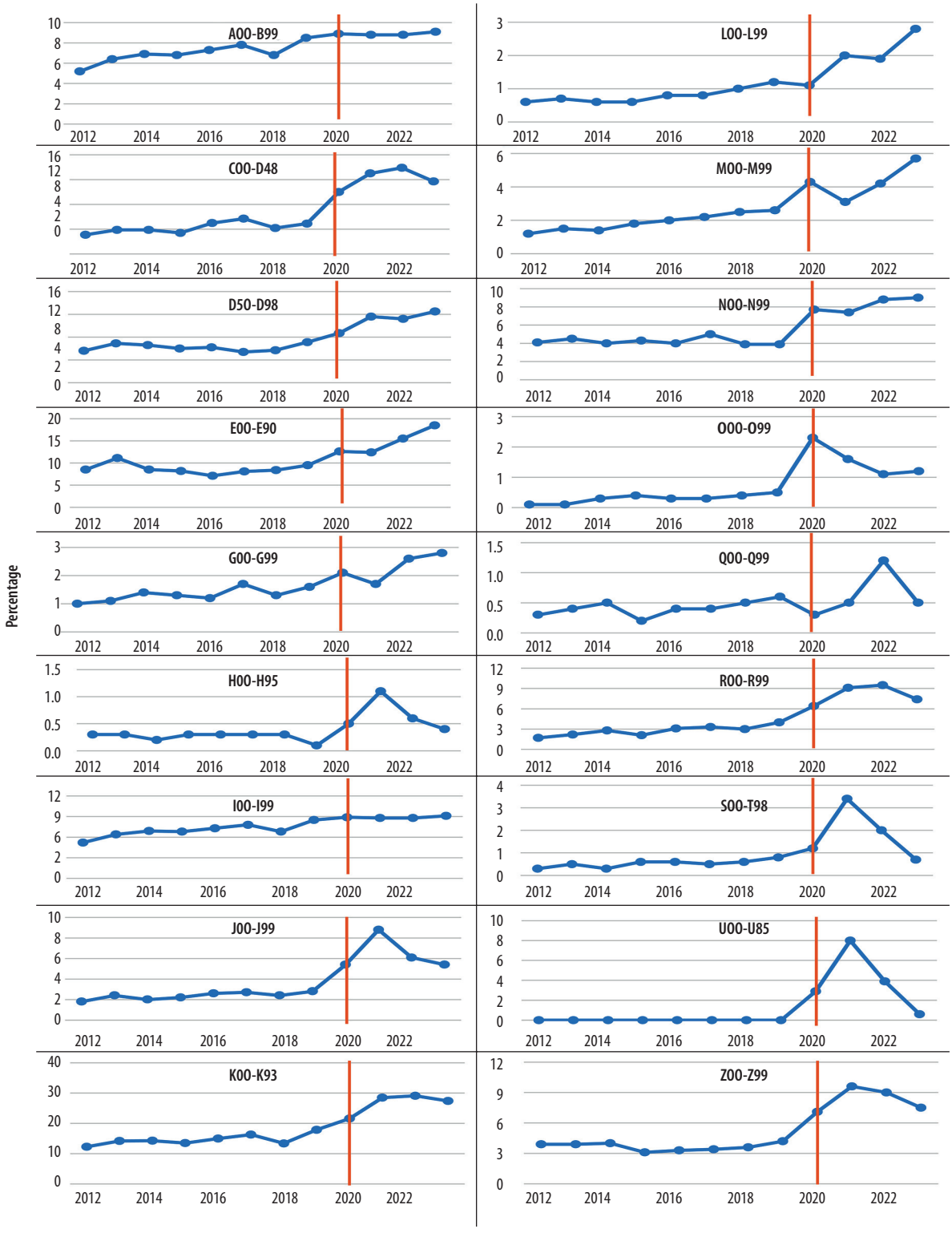

Figure 2. Temporal trends in ICD-10 comorbidity categories among patients hospitalized for the first time due to HBV infection, from 2012 to 2023. For an explanation of ICD-10 codes, please see the Material and Methods section. ICD-10, International Classification of Diseases, 10th Revision; HBV, hepatitis B virus.

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Figure 3. Temporal changes in the most clinically significant individual ICD-10 comorbid diagnoses among patients hospitalized for the first time due to HBV infection, 2012-2023. For an explanation of ICD-10 codes, please see the Material and Methods section. ICD-10, International Classification of Diseases, 10th Revision; HBV, hepatitis B virus.

and for other liver diseases (K76), rising continuously from 1.7% to 7.8% over the study period.

A growth-decline pattern, characterized by an increase followed by a slight decrease in 2022-2023, was observed for liver fibrosis and cirrhosis (K74), which rose from 4.0% in 2012 to 9.9% in 2022 before declining to 8.5% in 2023. Similar dynamics were observed for purpura and other hemorrhagic conditions (D69), hepatic failure (K72), chronic kidney disease (N18), and alcoholic liver disease (K70), all of which showed post-2019 increases with partial reductions in the most recent year.

A more abrupt or stepwise increase was observed for disorders of lipoprotein metabolism (E78), which declined until 2021 and then increased again to 4.5% in 2023; for anemias (D50-D53, D59-D64), rising sharply from 1.7% in 2012 to 7.4% in 2023; for diabetes mellitus (E10-E14), increasing from 1.9% to 4.6%; and for gastritis and duodenitis (K29), which demonstrated a noticeable post-2020 rise.

In contrast, cholelithiasis (K80) remained relatively stable over time, with minor fluctuations across the study period. A comparable overall low and moderately fluctuating pattern was observed for hepatocellular carcinoma (C22), which remained below 1.2% until 2019, increased to 2.5% in 2021, and subsequently stabilized at 1.7-1.8% in 2022-2023. Chronic HCV (B18.2) and HIV infection (B20-B24) also demonstrated relatively stable trends without marked long-term increases.

Age-specific patterns of comorbid diagnoses among patients hospitalized for the first time due to HBV infection are shown in **Figure 4**. A consistent age-dependent increase was observed across several conditions. Essential (primary) hypertension (I10), fibrosis and cirrhosis of the liver (K74), purpura and other hemorrhagic conditions (D69), diabetes mellitus (E10-E14), hepatic failure (K72), chronic kidney disease (N18), and cholelithiasis (K80) demonstrated progressive growth across successive age groups, reaching their highest proportions in older patients. In contrast, a growth-decline pattern was observed for disorders of lipoprotein metabolism (E78), anemias (D50-D53, D59-D64), alcoholic liver disease (K70), chronic HCV (B18.2), HIV infection (B20-B24), gastritis and duodenitis (K29), and hepatocellular carcinoma (C22). These diagnoses increased from young to middle-aged and early elderly groups, but declined in the oldest age categories. Overall, the age-stratified analysis demonstrated a shift from infection-related and selected metabolic

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

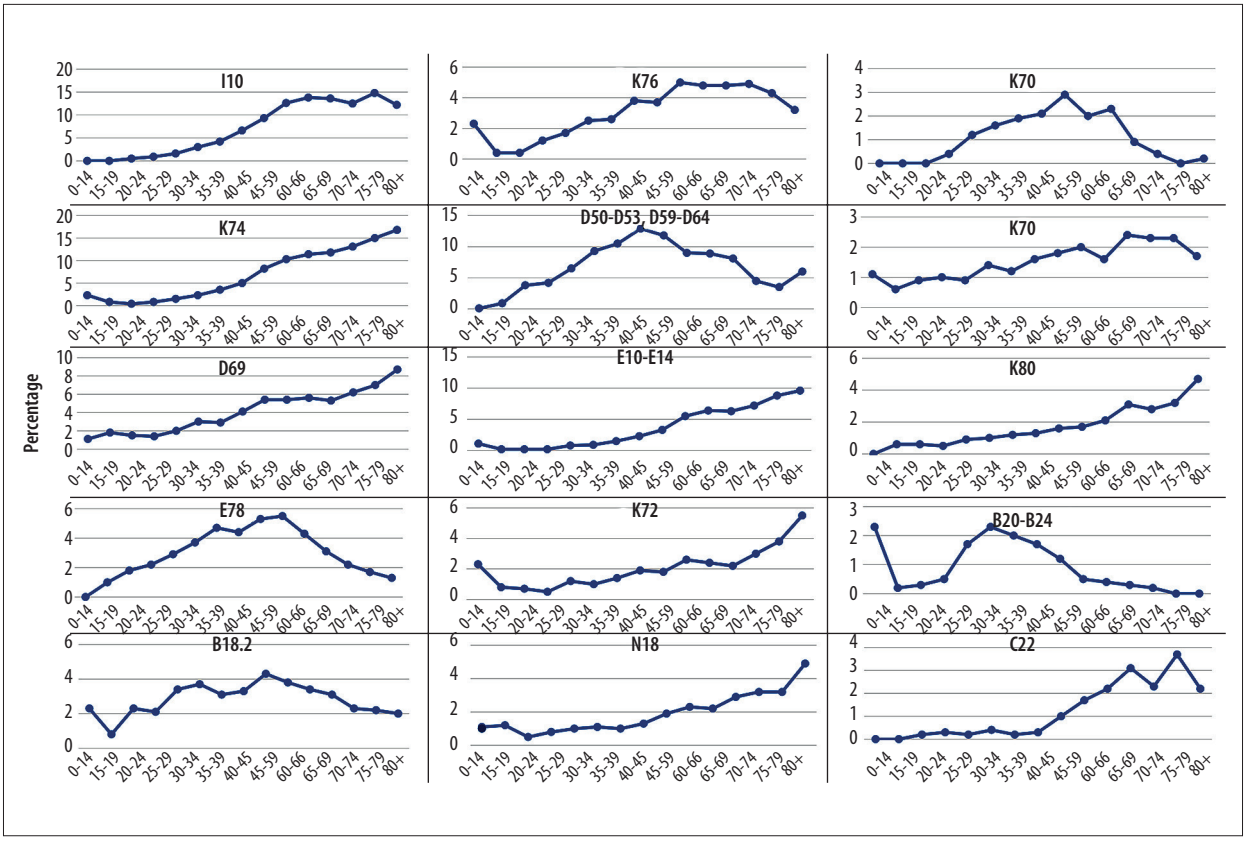

Figure 4. Age-specific distribution of the most clinically significant individual ICD-10 comorbid diagnoses among patients hospitalized for the first time due to HBV infection. For an explanation of ICD-10 codes, please see the Material and Methods section. ICD-10, International Classification of Diseases, 10th Revision; HBV, hepatitis B virus.

conditions in younger patients toward cardiometabolic, renal, and advanced hepatic diseases in older age groups.

Table 1 presents annual fatality rates, demographic characteristics, and age distribution of fatal hospitalizations. In total, 347 fatal hospitalizations were identified, representing 1.18% of all hospitalizations. Fatal cases were more frequently observed among men (67.1%), and the mean age at death was significantly lower in men than in women (58.8 vs 65.1 years; $P < 0.001$). The annual fatality rate per 1000 hospitalizations fluctuated during the study period. Between 2012 and 2019, the rate ranged from 6.8 to 15.9 per 1000 hospitalizations. A marked increase was observed in 2020-2023, ranging from 23.1 per 1000 to 30.7 per 1000. Despite these fluctuations, a statistically significant linear trend in fatal hospitalizations was identified over the entire period ($P < 0.005$; $R^2 = 0.66$). The proportion of male patients among fatal cases remained consistently higher than that observed in the general population ($P < 0.001$). The mean age of fatal cases ranged from 54.6 to 64.8 years across the study years, with the average age in 2012-2019 being 60.8 years, and during the COVID-19 pandemic, it increased to 61.2 years.

Discussion

This study is a continuation of the previously published research on trends and sociodemographic patterns of HBV hospitalization, examining comorbidities and fatalities among patients hospitalized for the first time with HBV during the 2012-2023 period [14]. As observed in the previous study, the incidence of first-time hospitalizations due to HBV infection declined steadily over the years, with a slight resurgence beginning in 2022. The average age of hospitalized patients has risen each year, reflecting the aging of the population. Our findings concur with the trend observed within the European Union (EU) population: according to estimates as of January 1, 2025, individuals aged 65 and older comprised 22% of the total EU population (450.6 million people), representing an increase of 0.4 percentage points relative to the previous year [22].

An examination of the age distribution among individuals infected with HBV, based on data from the Global Burden of Diseases (GBD) 2019 dataset, revealed that this specific population exhibits a higher proportion of individuals aged 60 and above compared with the general population, with an estimated prevalence of nearly 23% in 2019 (compared with 18% for

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

Table 1. Annual fatal hospitalizations, fatality rates, and demographic characteristics among patients hospitalized for the first time due to Hepatitis B virus infection, from 2012 to 2023 (n = 29 335).

Year	Total hospitalizations	Fatal hospitalizations			Fatality rate per 1000 hospitalized			Male patients (%)	Age (years)		
		Total	Men	Women	Total	Men	Women		Mean	Men	Women
2012	6770	58	35	23	8.6	8.4	8.9	60.3	59.4	59.6	59.2
2013	3852	31	24	7	8.0	10.0	4.8	77.4	64.8	62.3	73.3
2014	3262	40	25	15	12.3	12.6	11.7	62.5	63.2	59.3	69.6
2015	2839	28	21	7	9.9	12.2	6.3	75.0	60.8	60.0	63.3
2016	2662	18	13	5	6.8	8.3	4.6	72.2	54.6	52.8	59.2
2017	2139	24	17	7	11.2	12.9	8.5	70.8	63.3	60.2	70.7
2018	2514	24	19	5	9.5	13.1	4.7	79.2	60.9	57.7	73.2
2019	1760	28	14	14	15.9	13.8	18.7	50.0	57.5	49.0	66.0
2020	652	20	15	5	30.7	39.3	18.5	75.0	64.6	65.1	63.0
2021	638	20	13	7	31.3	33.2	28.3	65.0	60.5	60.2	60.9
2022	948	26	20	6	27.4	35.5	15.6	76.9	59.4	57.8	64.8
2023	1299	30	17	13	23.1	22.1	24.5	56.7	60.9	57.5	65.5

the general population) [23]. The proportion of persons aged 60 or older within the HBV-infected cohort increased from 9% in 1990 to 23% in 2019. Conversely, in the general population, this proportion increased from 9% to 18% [24]. These trends likely result from the successful implementation of HBV vaccination programs. In Poland, vaccination was introduced between 1994 and 1996, transforming the country from a region of medium endemicity to one of low endemicity. According to the 2019 GBD study, the proportion of individuals under 19 years of age has declined rapidly since the 1990s [24]. This trend was also documented in the European Center for Disease Prevention and Control 2023 report [25].

Furthermore, a significant predominance of hospitalized men (60%), compared with women (40%), has been observed, particularly in urban areas [14]. This may reflect differences in exposure patterns and healthcare utilization between the sexes, although the exact underlying reasons cannot be determined from the available data. This observation is consistent with data reported in the 2023 hepatitis B report, which shows a male-to-female ratio of 1.4 for chronic cases and 2.2 for acute cases [25]. The impact of biological sex on HBV prevalence is difficult to assess, as studies often focus on specific populations with known over-representation of men, such as people who inject drugs and men who have sex with men. The lower prevalence of chronic hepatitis B in women may be attributed to their reduced propensity for risky behavior, leading to decreased exposure, diminished susceptibility to acute infection, and an increased likelihood of clearance compared with men [26].

In our analysis, we exclusively evaluated patients who were hospitalized and received an HBV-related diagnosis for the first time, either as the principal or a secondary diagnosis. Over the years, the prevalence of all acquired diseases assessed in our study increased progressively. Between 2012 and 2023, there was an apparent rise in chronic non-communicable comorbidities. The most prevalent groups of comorbidities among patients infected with HBV consisted of disorders related to the digestive system, cardiovascular system, and metabolic conditions. Age-stratified analyses demonstrated a distinct shift from infection-related and specific hematological conditions in younger patients towards cardiometabolic, renal, and advanced hepatic diseases in older groups. This observation aligns with the trend observed in an aging population, where over time, metabolic homeostasis becomes disrupted, leading to the development of diabetes, cardiovascular diseases, and other metabolically driven comorbidities such as steatotic liver disease (SLD).

The burden of SLD and other chronic liver disorders further impacts already compromised hepatic function in individuals with HBV infection, contributing to the progression of fibrosis, as evidenced by the predominance of advanced hepatic diseases in older age groups [27]. Among the most commonly reported diseases, primary arterial hypertension had the highest prevalence and continued to increase over the years,

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

reaching 11% in 2023. Compared with available data on the general population, which indicates that approximately 32% of women and 34% of men are affected by primary arterial hypertension, the percentages reported across years in our study are relatively small. Nevertheless, the trend is evident and reflects that observed in other Western populations [28]. In a study of the Chinese population that assessed the association between HBV infection and metabolic syndrome, primary arterial hypertension was slightly lower than the estimated incidence in the general public, but still high at 25%. In comparison, elevated blood glucose was reported in over 8% of chronic hepatitis B patients [29].

In our study, the prevalence of diabetes mellitus increased consistently over the years, aligning with the overall trend observed in the European population; however, it constituted only 3% of all patients hospitalized. According to the 2021 GBD study, the global prevalence of diabetes is estimated at 6.1%. Moreover, worldwide, the prevalence of diabetes, irrespective of type, exceeds 20% among patients aged 65 to 95 years [30]. In Poland, data from the NGHMS conducted by the NIPH-NRI indicate that type 2 diabetes affected more than half of hospitalized patients [31]. Both primary arterial hypertension and diabetes mellitus were associated with an increased risk of liver-related events, and, furthermore, both also pose additional risk factors for disease progression and hepatocellular carcinoma in this cohort. Components of metabolic syndrome also have an additive effect in patients with multiple metabolic factor comorbidities, increasing the likelihood of liver-related events [32]. Interestingly, we noted a decline in disorders of lipoprotein metabolism (E78) in the oldest age categories. This phenomenon may be attributable to underreporting, as lipoprotein metabolism disorders are rarely the cause of hospitalization and are typically managed in outpatient settings. An increase in other hepatic diseases (K76) reporting (from 2% to 8%) was also observed, reflecting other liver diseases, including SLD, classified within this group. A recent global analysis estimated the prevalence of non-alcoholic fatty liver disease to be 32% [33]. An analysis of the prevalence of SLD among HBV-infected individuals conducted in Poland also estimated a rate of 32%, and among individuals qualified for metabolic dysfunction-associated SLD, the rate was 92% [34].

Next to primary arterial hypertension, the leading condition across all years was fibrosis and cirrhosis of the liver (K74). Its prevalence increased over the years, reaching 9.9% in 2022, then declined slightly to 8.5% in 2023. It was also observed that fibrosis and cirrhosis increased steadily across successive age groups and reached the highest proportions in the oldest patients. This likely reflects population aging and the cumulative burden of HBV infection, together with other metabolic and liver-related conditions such as SLD. Moreover, the liver is a sexually differentiated organ, and pre-menopausal women with chronic hepatitis B are at a lower risk of developing chronic liver disease due to the protective role of sex hormones compared with men [26]. The increasing burden of advanced liver fibrosis and cirrhosis is also reflected in the increase in prevalence of disorders of the blood and immune system (7% vs 13% in 2019 and 2022, respectively). Purpura and other hemorrhagic conditions were among the most common disorders across the entire study period (4%).

When assessing the increasing number of patients with advanced liver fibrosis and cirrhosis, alcohol consumption may be one of several contributing factors, as it is known to increase the risk of fibrosis in HBV-infected patients [35]. According to recent data, Poland is one of the few European countries where alcohol consumption increased between 2000 and 2020, a trend that was reflected in an increase in mortality due to alcoholic liver cirrhosis, affecting all age groups, as it has become the leading cause of death in the 2020s, particularly among women [36]. This is consistent with our findings, which show an increase in recorded diagnoses of alcoholic liver disease over time, with a slight decline observed in 2023. The incidence of alcoholic liver disease escalated with advancing age, reaching its peak in patients at 65 years of age, and subsequently declined. This pattern aligns with observations in the general population [36,37]. The most reliable indicator for assessing alcohol-related health damage is the mortality rate from alcoholic liver disease. Although the increase appears less pronounced in our study, likely attributable to underreporting, it nonetheless effectively illustrates the overall trend [36].

The estimated lifetime risk of developing hepatocellular carcinoma in patients infected with HBV is approximately 10% to 25% [38]. Furthermore, more than half of all cases of hepatocellular carcinoma worldwide are associated with chronic HBV infection [39]. The annual incidence of hepatocellular carcinoma is estimated to be below 1% in non-cirrhotic HBV-infected patients; however, this rate increases to 2% to 3% among patients who have cirrhosis. In our study, we observed a fluctuating pattern of hepatocellular carcinoma diagnoses, which remained below 1.2% until 2019. Subsequently, hepatocellular carcinoma diagnoses increased to 2.5% in 2021 and stabilized at approximately 1.7% to 1.8% from 2022 to 2023. The observed pattern of hepatocellular carcinoma diagnoses may be related to the concurrent increase in known risk factors, including cirrhosis, older age, male sex, and metabolic comorbidities [38,39].

Interestingly, within our studied cohort, only 3% of all patients throughout the entire study period had a concomitant diagnosis of chronic HCV infection (B18.2). According to the most recent nationwide analysis, HBsAg-positive patients represent 0.7% of all individuals with chronic HCV infection, whereas anti-HBc was reported in 14% [40]. The diagnosis of HIV fluctuated

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

throughout the study period but remained below a 2% rate, despite a slight yet steady increase observed since 2020. This upward trend could potentially be attributed to the migration wave from Ukraine, as recent studies conducted in Poland confirm a higher prevalence of not only HIV among Ukrainian populations but also other blood-borne viruses [41,42]. However, the underlying causes cannot be determined from the data available in the present study.

A main strength of this study is the use of a nationwide hospital discharge dataset from the NGHMS, which includes all hospitalization cases in Poland over 12 years. The dataset, collected via digital systems as part of public statistical research, is highly complete, with missing information typically not exceeding 1%.

A key limitation is the anonymization of patient data, which prevents verification of the complete accuracy of the reported causes of hospitalization and comorbidities. Nevertheless, the data are considered reliable, as all hospitals have a legal obligation to report specific data on hospitalizations, including the primary diagnosis and comorbidities. Another limitation arises from the nature and structure of the administrative dataset, which is primarily designed for reporting rather than detailed clinical analysis. As a result, the analyses were mainly descriptive and did not include multivariable modeling, since key variables, including disease severity, laboratory parameters, and treatment data, required robust adjustment or were not available. Consequently, potential confounding factors could not be fully accounted for. Future studies based on more detailed clinical datasets should incorporate multivariable approaches to better identify independent predictors of outcomes, particularly mortality. Furthermore, an enhanced surveillance system may be more helpful in targeted public health interventions. Another limitation of our study was that no psychiatric codes were included in the analysis, possibly because those diagnoses are exclusively treated at specialized psychiatric centers and therefore are not included in the discharge. This is partly because psychiatric diagnoses are typically treated at specialized psychiatric centers and are reported through a separate statistical reporting pathway: institutions providing psychiatric care submit hospitalization data within the Public Statistics Research Program to the Institute of Psychiatry and Neurology in Warsaw. However, it is important to consider that patients with HBV infection were identified as having a higher risk for anxiety and depression [43]. Furthermore, an analysis of direct-acting antiviral treatment in patients infected with HCV, conducted within a Polish population possessing mental health disorders, demonstrated that individuals with HCV and concurrent mental illness are significantly more frequently co-infected with HBV in comparison with the population lacking psychiatric conditions [44]. The exclusion of this category may therefore slightly underestimate the overall comorbidity burden. Although preliminary data suggest that the study group's comorbidity rate may be slightly higher, more detailed information from the national hospital morbidity registry is not yet available. Future improvements in disease-reporting systems would enable more accurate assessment of comorbidity patterns. Such enhanced surveillance would deepen the understanding of HBV hospitalization trends and related factors, supporting targeted public health interventions.

Conclusions

The comorbidity profile of patients hospitalized with HBV was increasingly dominated by chronic non-communicable diseases, particularly cardiometabolic and advanced hepatic conditions, alongside observed changes over time. The post-2019 structural shift and the age-related gradient suggest increasing complexity of multimorbidity in HBV care. These findings highlight the importance of integrated, multidisciplinary, and age-tailored management approaches that extend beyond infection-focused care.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

References:

1. Pondé RA de A, Amorim G de SP. Elimination of the hepatitis B virus: A goal, a challenge. Med Res Rev. 2024;44:2015-34
2. WHO. Hepatitis B 2022. https://www.who.int/news-room/fact-sheets/detail/hepatitis-b (accessed May 14, 2023)
3. Kasianchuk N, Dobrowolska K, Harkava S, et al. Gene-editing and RNA interference in treating hepatitis B: A review. Viruses. 2023;15:2395
4. Not A, Ouaarab-Essadek H, Montoro M, et al. Hepatitis B and C screening and linkage to care in migrants from endemic countries in Barcelona through a community action. Liver Int. 2025;45:e70126
5. Li C, Thapa D, Mi Q, et al. Disparities in hepatitis B virus healthcare service access among marginalised poor populations: A mixed-method systematic review. Infect Dis Poverty. 2024;13:58
6. Gao L, Ren Y, Hu S, et al. Global, regional, and national total burden related to hepatitis B and attributable risk factors in adults aged 65 years and older from 1990 to 2021 and projection to 2030. Front Public Health. 2025;13:1654356
7. Nakitanda AO, Montanari L, Tavoschi L, et al. Hepatitis B virus infection in EU/EEA and United Kingdom prisons: A descriptive analysis. Epidemiol Infect. 2021;149:e59
8. Trickey A, Bivegete S, Duffell E, et al. Estimating hepatitis B virus prevalence among key population groups for European Union and European Economic Area countries and the United Kingdom: A modelling study. BMC Infect Dis. 2023;23(1):457

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]

9. Kopacz A, Kubicka-Russel D, Liszewski G, et al. Hepatitis B virus in Polish blood donors in the period 2005-2019-significant changes in epidemiology and demographic characteristics of infected donors. Viruses. 2025;17(1):60
10. Magdzik W, Czarkowski MP. Epidemiological situation of hepatitis B in Poland in the years 1979-2004. Przegl Epidemiol. 2006;60:471-80
11. Kowalczyk M, Wiktor A, Stępień M. Hepatitis B in Poland in 2019. Przegl Epidemiol. 2021;75:367-78
12. Zięba K, Jagiełło K, Musialik J, et al. Anti-HBs positivity related to past HBV infection and vaccination in older adults in polish population-cohort-based study. Vaccines (Basel). 2024;13:18
13. Czarkoski MP, Wielgosz U. Vaccinations in Poland in 2023. Narodowy Instytut Zdrowia Publicznego. 2024. https://wwwold.pzh.gov.pl/oldpage/epimeld/2023/Sz_2023.pdf (accessed April 28, 2025) [in Polish]
14. Genowska A, Dobrowolska K, Zarębska-Michaluk D, et al. Trends and socio-demographic patterns of hepatitis B virus hospitalisations in Poland: A 12-year nationwide analysis. J Viral Hepat. 2025;32:e70059
15. Mahase E. Hepatitis: Ukrainian refugees should be offered vaccines and free treatment, says WHO. BMJ. 2022;377:o1132
16. Rzymski P, Zarębska-Michaluk D, Parczewski M, et al. The burden of infectious diseases throughout and after the COVID-19 pandemic (2020-2023) and Russo-Ukrainian war migration. J Med Virol. 2024;96(5):e29651
17. Stępień M, Zakrzewska K, Rosińska M. Significant proportion of acute hepatitis B in Poland in 2010-2014 attributed to hospital transmission: Combining surveillance and public registries data. BMC Infect Dis. 2018;18:164
18. Lichtensztajn DY, Giddings BM, Morris CR, et al. Comorbidity index in central cancer registries: The value of hospital discharge data. Clin Epidemiol. 2017;9:601-9
19. Khan A, Uddin S, Srinivasan U. Chronic disease prediction using administrative data and graph theory: The case of type 2 diabetes. Expert Syst Appl. 2019;136:230-41
20. Kassada DS, Rocha I de LP, Eberhardt LD. Hepatitis B hospitalizations in Brazil: Temporal and regional patterns from 2008 to 2023. Viruses. 2025;17:348
21. World Health Organization. Combating hepatitis B and C to reach elimination by 2030. 2016. https://www.who.int/publications/i/item/combating-hepatitis-b-and-c-to-reach-elimination-by-2030 (accessed April 28, 2025)
22. Eurostat. Population structure and ageing 2024. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing (accessed February 11, 2025)
23. GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019. Lancet Gastroenterol Hepatol. 2022;7:796-829
24. Xie J, Wang X, Pan D, et al. Ageing and non-liver comorbidities in population with chronic hepatitis B infection in the western pacific region from 1990 to 2019. Front Physiol. 2023;14:1176113
25. European Centre for Disease Prevention and Control. Hepatitis B – annual epidemiological report 2023. 2025. https://www.ecdc.europa.eu/en/publications-data/hepatitis-b-annual-epidemiological-report-2023 (accessed March 2, 2026)
26. Brown R, Goulder P, Matthews PC. Sexual dimorphism in chronic hepatitis B virus (HBV) infection: Evidence to inform elimination efforts. Wellcome Open Res. 2022;7:32
27. Zhong D, Sun Y, Zhao L, et al. Interplay between aging and metabolic diseases: From molecular mechanisms to therapeutic horizons. Med Rev (Berl). 2025;5:477-89
28. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: A pooled analysis of 1201 population-representative studies with 104 million participants. Lancet. 2021;398:957-80
29. Yan L-B, Liao J, Han N, et al. Association between hepatitis B virus infection and metabolic syndrome in Southwest China: A cross-sectional study. Sci Rep. 2020;10:6738
30. GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: A systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2023;402:203-34
31. Poznańska A, Goryński P, Seroka W, et al. Nationwide General Hospital Morbidity Study as a source of data about Polish population health. Przegl Epidemiol. 2019;73:69-80
32. Patmore LA, Carey I, Feld JJ, et al. Prediction of hepatocellular carcinoma and other liver-related events in chronic hepatitis B patients with metabolic dysfunction or metabolic dysfunction-associated steatotic liver disease. Aliment Pharmacol Ther. 2026;63:374-82
33. Riazi K, Azhari H, Charette JH, et al. The prevalence and incidence of NAFLD worldwide: A systematic review and meta-analysis. Lancet Gastroenterol Hepatol. 2022;7:851-61
34. Janczura J, Brzdęk M, Dobrowolska K, et al. Steatotic liver disease in patients treated for chronic hepatitis B. Pol Arch Intern Med. 2025;135(3):16942
35. Ganesan M, Eikenberry A, Poluektova LY, et al. Role of alcohol in pathogenesis of hepatitis B virus infection. World J Gastroenterol. 2020;26:883-903
36. Zatońska K, Psikus P, Basiak-Rasała A, et al. Patterns of alcohol consumption in the PURE Poland cohort study and their relationship with health problems. Int J Environ Res Public Health. 2021;18:4185
37. Janik-Koncewicz K, Zatoński W. Alcohol as a public health threat in Poland: Rising consumption, weakening policy, and increasing mortality. J Health Inequal. 2025;11:112-18
38. McGlynn KA, Petrick JL, El-Serag HB. Epidemiology of hepatocellular carcinoma. Hepatology. 2021;73:4-13
39. Abdelhamed W, El-Kassas M. Hepatitis B virus as a risk factor for hepatocellular carcinoma: There is still much work to do. Liver Res. 2024;8:83-90
40. Zarębska-Michaluk D, Brzdęk M, Rzymski P, et al. Hepatitis B virus coinfection in patients treated for chronic hepatitis C: Clinical characteristics, risk of reactivation with long-term follow-up, and effectiveness of antiviral therapy. Pol Arch Intern Med. 2024;134(1):16638
41. Genowska A, Zarębska-Michaluk D, Parczewski M, et al. Impact of the COVID-19 and war migration on HIV/AIDS epidemiology in Poland. J Clin Med. 2024;13:4106
42. Flisiak R, Zarębska-Michaluk D, Martonik D, et al. Treatment of hepatitis C virus infections among patients of Ukrainian origin during the influx of war refugees to Poland. J Clin Med. 2024;13:7641
43. Low CE, Ge G, Yeong TJJ-M, et al. Burden of psychological symptoms and disorders among individuals with hepatitis B: A systematic review, meta-analysis and meta-regression. Front Psychiatry. 2025;16:1546545
44. Dybowska D, Zarębska-Michaluk D, Rzymski P, et al. Real-world effectiveness and safety of direct-acting antivirals in hepatitis C virus patients with mental disorders. World J Gastroenterol. 2023;29:4085-98

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS]