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Prevalence of chronic hepatitis B virus infection among children in Uzbekistan: Impact of vaccination

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Abstract

Background: Uzbekistan, a highly endemic country for hepatitis B virus (HBV), introduced infant vaccination with hepatitis B vaccine (HepB) in 2001. Since 2002, it had ≥90 % reported immunization coverage for ≥3 doses of HepB (HepB3) and the birth dose (HepB-BD). However,

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CRediT authorship contribution statement

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Declaration of competing interest

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the impact of HepB vaccination and the progress towards achieving the regional hepatitis B control and global viral hepatitis B elimination goals had not been assessed.

Methods: To determine current HBsAg prevalence among children in Uzbekistan, in 2022, we conducted a nationwide serosurvey among schoolchildren (grades 1–3) using a stratified, multi-stage cluster design. Participants' basic demographics and HepB immunization information were obtained. Blood specimens were tested for HBsAg using a WHO-prequalified rapid test (Bioline HBsAg WB, Abbott Diagnostics). Samples with positive and indeterminate results were tested for HBsAg by ELISA (Murex HBsAg Version3, Diasorine). Weighted proportions and adjusted 95 % confidence intervals (CI) were calculated.

Results: Of 4119 children enrolled in 148 schools, blood was collected from 3753 (91.1 %) and immunization data were available for 3833 (93.3 %). National HBsAg prevalence was 0.20 % (adjusted 95 % CI, 0.09 %–0.38 %). Among children with available immunization data, 97.7 % (97.2 %–98.1 %) received ≥ 3 HepB doses and 94.9 % (94.1 %–95.5 %) received HepB-BD, including timely HepB-BD in 93.7 % (92.9 %–94.5 %).

Conclusions: The survey demonstrated that Uzbekistan has met the <0.5 % European regional HBsAg seroprevalence target and has made substantial progress towards meeting the <0.1 % HBsAg seroprevalence target for the elimination of HBV mother to-child transmission (MTCT). Based on these findings and ≥ 90 % HepB-BD and HepB3 coverage, in 2023, Uzbekistan was validated as having achieved the regional hepatitis B control goal. To achieve the elimination of MTCT of HBV, additional interventions, including improving antenatal screening for HBsAg, providing antiviral treatment of eligible HBsAg-positive pregnant women and hepatitis B immunoglobulin to infants born to HBsAg-positive mothers, should be considered.

Keywords

Hepatitis B; Serosurvey; Uzbekistan; HBsAg prevalence; Viral hepatitis; Viral hepatitis elimination; Hepatitis B vaccination

1. Introduction

Worldwide, hepatitis B virus (HBV) is associated with substantial morbidity and mortality. An estimated 254 million persons were living with chronic HBV infection and an estimated 1.1 million persons died from HBV-related causes, primarily cirrhosis and liver cancer, globally in 2022. Of these, the World Health Organization (WHO) European Region accounted for 10.6 million and 32,000 persons, respectively [1].

Hepatitis B remains a substantial public health problem in Uzbekistan, a lower-middle income country in Central Asia and a Member State of the WHO European Region (2023 population, 36 million) [2]. Historically, Uzbekistan was considered a country with high-intermediate to high level of HBV endemicity.¹ Estimates of prevalence of chronic HBV infection in Uzbekistan based on statistical modelling suggest a high burden in the pre-vaccine era with prevalence of HBV surface antigen (HBsAg), a marker of chronic/

¹HBV endemicity levels based on the prevalence of HBsAg are defined as: low - <2 %, low-intermediate - $2-4$ %, high-intermediate $5-7$ %, and high ≥ 8 % [3].

active HBV infection, between 5.51 % and 13.1 % [3–8]. Recent estimates indicate decline in overall HBsAg prevalence in the general population to intermediate levels (range of estimates for all ages, 2.1 %–4.3 %; for children <5 years – 0.1 %–0.4 %) [8,9]. However, no nationally representative population-based serosurveys have been conducted to directly measure HBV infection prevalence in Uzbekistan.

A safe and effective vaccine against hepatitis B has been available for more than 30 years [10]. Hepatitis B vaccine introduction into the national immunization schedule of Uzbekistan began in 1997 in parts of the country, with nationwide introduction in October 2001 [11]. Initially, the national immunization schedule comprised three doses of monovalent hepatitis B vaccine, including birth dose. Since the introduction of pentavalent vaccine containing diphtheria, tetanus, whole cell pertussis, *Hemophilus influenzae* type B, and hepatitis B components (DTwP-HiB-HepB) in 2009, the following schedule has been in place: hepatitis B monovalent vaccine (pediatric) at birth (recommended within 24 h of life) and pentavalent vaccine at 2, 3 and 4 months. Reported immunization coverage with hepatitis B vaccine in Uzbekistan has been historically very high (Fig. 1). WHO-UNICEF estimates concur with officially reported data [12]. A Multiple Indicator Cluster Survey (MICS) conducted in 2006 has also shown high coverage [13].

Coverage with ≥ 3 doses of hepatitis B vaccine (HepB3) has been ≥ 95 % for all years since 2003 except 2008, when HepB3 coverage was 91 % because of a vaccine stockout.² Coverage with the birth dose of hepatitis B vaccine (HepB-BD) has also been consistently ≥ 95 % since 2002, except for 2010, when HepB-BD coverage fell to 48 % because of supply problems related to changes in the vaccine procurement mechanism in Uzbekistan (Fig. 1). Coverage with hepatitis B vaccine is uniformly high throughout the country, without any substantial subnational variations.

Implementation of hepatitis B vaccination through routine immunization programs of many countries beginning in the late 1980s has helped to dramatically reduce the HBV infection prevalence even in settings of high endemicity [14–19]. In Uzbekistan, the surveillance data for acute hepatitis B infections also suggest a substantial decline over the last two decades (unpublished data, MOH; Fig. 2), although other factors, such as improvement of hygienic standards in medical procedures, and injection and blood safety, have likely contributed to the overall decline.

Uzbekistan has endorsed the WHO goal of elimination of viral hepatitis as a public health threat by 2030, adopted by World Health Assembly in 2016 [20–22]. As an interim step towards elimination, Uzbekistan has also adopted the regional hepatitis B control goal set by the WHO European Region in 2015, with a target of <0.5 % prevalence of chronic HBV infection in vaccinated cohorts [23–26].

The Regional Hepatitis B Working Group of the European Technical Advisory Group of Experts on Immunizations (ETAGE) developed a framework and criteria for validation of the achievement of regional hepatitis B control goals by countries [24]. In addition to achieving

²Catch-up immunization in this birth cohort was conducted when the vaccine became available through humanitarian aid.

the impact target of <0.5 % HBsAg prevalence, validation of the achievement of regional hepatitis B control goal by countries requires demonstration of ≥ 90 % coverage with timely hepatitis B-BD (i.e. administered within 24 h of birth) and HepB3 for at least three years [24].

Although hepatitis B vaccine has been used in Uzbekistan with high coverage for more than 20 years, no population-based assessments of the impact of hepatitis B vaccination in Uzbekistan have been previously implemented. Therefore, we conducted a cross-sectional survey of the prevalence of HBsAg, a marker of chronic HBV infection, to obtain population-based data on HBV infection prevalence among children in Uzbekistan, assess the impact of hepatitis B vaccination, measure progress towards achieving regional hepatitis B control goal, and help to better characterize the burden of hepatitis B in the country. The survey also provided an opportunity to assess hepatitis B vaccination status of the surveyed population.

2. Methods

2.1. Survey design

The serosurvey followed WHO guidance on conducting serosurveys to assess hepatitis B vaccination impact [27–29]. This was a nationwide cross-sectional serosurvey which targeted children aged 6–8 years. The presence of HBsAg was considered as evidence of chronic HBV infection [28].³

Due to the very high rate of primary school enrollment in Uzbekistan (96 %–98 %) [29], the survey was conducted through the school system. The sampling frame comprised children enrolled in grades 1–3 in 2021 (corresponding ages, 6–8 years) in schools of Uzbekistan. All public and private schools and specialized educational institutions in Uzbekistan having grades 1–3 were eligible for inclusion.

The required sample size was estimated (through the Wilson method with continuity correction) using the expected prevalence of 0.5 % (the regional target), ± 0.25 % margin of error, and confidence level 95 %, resulting in minimum 3603 children needed to be enrolled in the serosurvey. The number was increased to account for a design effect of 1.2 and 15 % non-response, resulting in a minimum sample size of 5087 children to be targeted for enrolment in the serosurvey.

Multi-stage stratified cluster design was used for sample selection (Fig. 3). A primary sampling unit or a cluster was defined as a 2nd level administrative unit (districts and cities; hereinafter referred to as “districts”), a secondary sampling unit was a school with grades 1–3, and a tertiary sampling unit was a class. All students in a selected class were eligible for participation.

All 2nd level administrative units in Uzbekistan ($n = 202$) were stratified by their population size. Districts were arranged by population size in descending order and divided into three

³Although HBsAg is present during acute/recent HBV infection, encountering recent infection in a cross-sectional population survey in a low HBV incidence setting is highly unlikely [28].

strata with 1/3 of the total population in each one. The upper tercile (stratum 1) included largest districts, the middle tercile (stratum 2) – medium sized districts, and lower tercile (stratum 3) – smaller districts. A total of 37 districts (12–13 districts per stratum) were selected by simple random sampling (SRS) using random number generator. The selected districts were distributed across all 14 first level administrative units (hereinafter referred to as “regions”), which include Tashkent City, 12 regions, and the Republic of Karakalpakstan.

Secondary sampling units (SSU) were defined as schools in selected districts which had primary grades. Lists of all schools with primary grades in the districts selected for serosurvey were obtained and SSU selection was performed for each district separately. Schools were stratified into two strata by size according to the number of students in primary grades (above and below 50th percentile). Two schools per stratum (a total of four schools per district) and a total of 148 schools nationwide were selected by SRS. Finally, one class per school was selected by SRS from the list of all classes in grades 1–3 in a given school in the 2021–2022 school year and all children in the selected classes were invited to participate in serosurvey.

Because of the enrollment by class and variability of class sizes, the actual total number of participants could not be known before the survey implementation. Assuming an average class size of 35, the expected number of children in selected classes was estimated as 5180, consistent with the required sample size.

2.2. Survey procedures

Sampling at all levels was performed by the survey staff. Schools, in collaboration with the survey staff, contacted caregivers of the children in classes selected for the survey, provided them with the information about the survey, explained the survey benefits and risks, and invited their children’s participation. After obtaining informed consent from the caregiver, 3–5 ml of whole venous blood was collected by venipuncture from participating children by trained nurses, with adherence to strict infection control measures. The serosurvey enrolment took place during May–October 2022.

The information collected about participants included basic demographics (sex, age, date of birth, school, and place of residence) and hepatitis B immunization status (type of vaccine and date of vaccination for each dose). Vaccination data were obtained from children’s immunization records requested from local healthcare facilities. To avoid participation bias and ensure that immunization information was representative of the entire population, immunization records were requested for all children in the selected classes, irrespective of their subsequent participation status.

The blood samples were transported the same day to local public health laboratories, where they were tested for HBsAg using rapid test and where serum separation took place, if needed. Serum specimens of children with positive and indeterminate results of rapid test, as well as a subset of samples with negative results, were transported under cold chain to the Institute of Virology laboratory in Tashkent for confirmatory testing and quality assurance purposes.

2.3. Laboratory methods

Laboratory testing to assess prevalence of HBV infection was performed in accordance with WHO guidelines for conducting serosurveys to demonstrate the impact of hepatitis B immunizations [27,28]. All samples were tested for HBsAg using a WHO prequalified rapid test (Bioline HBsAg WB, Abbott Diagnostics Korea Inc).

Rapid diagnostic tests (RDTs) are widely used for hepatitis B seroprevalence surveys per WHO recommendations [28], particularly in resource-limited settings, and for point-of-care diagnostics. The test used in this serosurvey is one of the two RDTs for HBsAg pre-qualified by WHO [30]. The high sensitivity [100 % (98.1 %–100 %)] and specificity [99.0 % (97.2–99.8 %)] of the test reported by the manufacturer have been corroborated in the field in numerous serosurveys and screening/diagnostic programs [31–35].

Testing was conducted locally, by trained staff from district or regional public health laboratories, or, for specimens from Tashkent City and Tashkent Region, at the Institute of Virology. As recommended by WHO for settings with low prevalence of HBV infection [27], specimens that were positive in initial rapid test underwent additional confirmatory testing by ELISA using a WHO-prequalified test-system (Murex HBsAg Version3, Diasorin, Italy) at the Institute of Virology laboratory, which serves as Uzbekistan's national reference laboratory for hepatitis B and C. Specimens with indeterminate results of rapid tests and ~ 10 % of those with negative results were also tested with ELISA. Only children with positive results in confirmatory testing were considered HbsAg-positive.

2.4. Data management and analysis

The data entry was performed using statistical software Epi Info (version 7.2.3.1; CDC, Atlanta). Data analysis was conducted using R (version 4.3; R Foundation for Statistical Computing, Vienna, Austria). The main outcome measure was HBV infection seroprevalence (the percentage of HBsAg-positive specimens) and 95 % confidence intervals (CI) for proportions (Wilson method with continuity correction). The estimates were adjusted to account for the survey design and sampling weights.

The main outcome measure for immunization status of population for hepatitis B were the proportions of children who, by the time of the serosurvey, had received recommended ≥ 3 doses of hepatitis B vaccine, a HepB-BD, and a timely HepB-BD. The survey was not powered to provide subnational estimates and targeted a narrow age range; therefore, subnational and detailed age-specific estimates were not calculated.

2.5. Ethical considerations

The serosurvey protocol was approved by the Ethics Committee of the Ministry of Health of Uzbekistan. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy. Review by CDC's Institutional Review Board was not applicable.

3. Results

3.1. Survey participants

A total of 4119 children were enrolled in classes selected in the 148 participating schools (median, 29 children per class, range, 12–50) throughout Uzbekistan. Parents/caregivers of 3759 (91.3 %) children agreed to their participation in the survey. Blood specimen was obtained from 3753 (91.1 % of total) children (these children are subsequently considered as “enrolled” in the survey). Immunization records were available for 3833 (93.3 %) children. The details of enrollment and the availability of immunization records are given in Fig. 4.

Information on participant sex was available for 3741 or 99.7 % of the enrolled children; 1932 (51.6 %) were male and 1809 (48.4 %) were female. Age was available for 3710 children, with a median of 8 years (range, 6–10 years). The distribution of participants by 1st level administrative unit (regions) is given in Table 1.

3.2. Prevalence of chronic HBV infection

HBsAg was detected in six of 3753 participants tested, for a weighted prevalence of 0.20 % (adjusted 95 % CI, 0.09 %–0.38 %) (Table 2). Among the six HBsAg-positive children, three (50 %) were male and three (50 %) were female; five (83.3 %) were 8-years old and one (16.7 %) was 7-years old. These children resided in four regions of Uzbekistan – two each in Fergana and Samarkand regions, and one each in Bukhara and Surkhondaryo regions. The HBsAg-positive children in Fergana region were from the same school, while HBsAg-positive children from Samarkand region resided in different districts. Five of the six HBsAg-positive children had received timely HepB-BD and a total of ≥ 3 doses of hepatitis B vaccine. Immunization records for one HBsAg-positive child were unavailable.

3.3. Hepatitis B immunization status

The results of the analysis of hepatitis B immunization status of children in selected classes are given in Table 2. Almost all children with available immunization data (3822 of 3833; for a weighted percentage 99.8 %; adjusted 95 % CI, 99.6 %–99.9 %) had received at least 1 dose of hepatitis B vaccine, while 3745 (weighted percentage, 97.7 %; adjusted 95 % CI, 97.2 %–98.1 %) had received the recommended full series of ≥ 3 doses of hepatitis B vaccine (Table 2).

HepB-BD was given to 3635 (weighted percentage, 94.9 %; adjusted 95 % CI, 94.1 %–95.5 %) of 3817 children for whom the information on the birth dose was provided. HepB-BD was administered timely to 3349 of 3592 children for whom both dates of birth and receipt of HepB-BD were reported, for a weighted proportion of 93.7 % (adjusted 95 % CI, 92.9 %–94.5 %). An additional 180 (weighted percentage 4.7 %; adjusted 95 % CI, 4.1 %–5.5 %) children had received HepB-BD at age 2–7 days; the remaining 63 (weighted percentage 1.6 %; adjusted 95 % CI, 1.2 %–2.0 %) children were vaccinated with HepB-BD at age 8–30 days. There were no statistically significant differences by sex in the availability of immunization records and in the proportions of recipients of HepB-BD, timely HepB-BD and ≥ 3 doses of HepB (data not shown).

4. Discussion

The present survey, the first population based national hepatitis B serosurvey in Uzbekistan, revealed that nationwide HBsAg prevalence among children enrolled in primary school grades 1–3 in 2021 was low at 0.20 % (95 % CI, 0.09 %–0.38 %). This level of HBsAg prevalence among children is below the 0.5 % European regional hepatitis B control target [23,24], demonstrating the profound impact of more than 20 years of successful routine hepatitis B vaccination in Uzbekistan.

The results of this serosurvey, in combination with high reported coverage with timely HepB-BD and ≥ 3 doses of hepatitis B-containing vaccines, were instrumental in validating Uzbekistan's achievement of the European regional hepatitis B control goal by the ETAGE Hepatitis B Regional Working Group in 2023 [36]. The formal process of validation of the achievement of hepatitis B control by the countries in the European Region was initiated in 2019. As of 2023, nine of the 53 Member States have been validated, including Uzbekistan⁴ [36].

To ensure continued low prevalence of HBV infection among children in the future, high infant immunization coverage with a timely HepB-BD and the full series of ≥ 3 doses of hepatitis B-containing vaccines in Uzbekistan will be needed. With sustained high coverage, overall HBsAg prevalence in Uzbekistan's general population will likely further decline as more vaccinated cohorts reach adulthood, and the burden of hepatitis B in Uzbekistan will increasingly shift to age groups born before vaccine introduction.

The survey also demonstrated that the country has made substantial progress towards achieving the elimination of mother-to-child transmission (MTCT) of HBV, the major cause of chronic HBV infections [25,37,38]. Elimination of HBV MTCT is an essential component of the elimination of viral hepatitis as public health threat and has recently been included, along with the elimination of MTCT of HIV and syphilis, as the third component of the WHO "triple elimination" initiative [37,38]. WHO has defined HBsAg prevalence of ≤ 0.1 % as the impact indicator of the global elimination of mother to-child transmission [25,37–39].

The key intervention to prevent MTCT of HBV is vaccination of newborns with hepatitis B vaccine at birth, ideally within 24 h [10]. Timely HepB-BD is extremely effective in preventing perinatal transmission of HBV [10]. However, protection is not 100 % and transmission could still occur in certain situations, e. g. when mother's HBV viral load is very high or when the virus is transmitted before birth. Therefore, in addition to timely HepB-BD vaccination, WHO also recommends additional interventions to prevent MTCT of HBV including antenatal screening of pregnant women for hepatitis B, administering hepatitis B immunoglobulin (HBIG) at birth to infants born to eligible HBsAg-positive mothers, and antiviral treatment of HBsAg-positive pregnant women [10,40,41].

⁴Belarus, Georgia, Italy, Kyrgyzstan, Moldova, the Netherlands, Turkmenistan, the United Kingdom, and Uzbekistan; in addition, Croatia received conditional validation in 2019.

High coverage with HepB-BD in Uzbekistan has clearly contributed to the observed low levels of HBsAg among children. However, strengthening additional interventions to prevent MTCT is needed. Currently, antenatal screening of pregnant women for hepatitis B is in place, but the coverage with screening is not systematically monitored. HBIG for newborns of HBsAg-positive mothers and antiviral treatment for eligible pregnant women are not currently available in Uzbekistan. To decrease HBsAg seroprevalence to levels consistent with the elimination of MTCT of HBV, antenatal screening for hepatitis B of all pregnant women and systematic monitoring of coverage with antenatal screening are needed in all regions of in Uzbekistan. Antiviral treatment with tenofovir for eligible HBsAg-positive pregnant women is also needed. Implementation of recently updated WHO guidelines for chronic HBV infection treatment with simplified eligibility criteria for pregnant women in resource-limited settings could help increase access to treatment for HBsAg-positive pregnant women in Uzbekistan [41]. In addition, policy makers could consider the feasibility of providing of HBIG at birth to infants born to HBsAg-positive mothers.

Along with achieving the elimination of MTCT of HBV, countries must meet several other programmatic and impact indicators reflecting the reduction of disease burden and successful implementation of preventive interventions in order to achieve the elimination of viral hepatitis as a public health problem by 2030 [22,39,41]. Addressing the substantial burden of HBV in Uzbekistan has been long recognized as a priority [7,42–45]. The success of the national hepatitis B vaccination program has created solid foundation for the elimination of hepatitis B elimination as a public health threat. However, implementation of other key interventions for viral hepatitis elimination, such as large-scale population screening, linkage to care and provision of antiviral treatment, implementation of preventive measures in key populations, and strengthening infection prevention and control practices, has been challenged by the insufficient resources.

Because of the lack of any major donor-funded initiatives supporting viral hepatitis elimination in low- and middle-income countries, viral hepatitis elimination activities in Uzbekistan have been expanding gradually. The Ordinance N°537 of the Cabinet of Ministers from 24 July 2017 (“On additional measures to prevent spread of infectious diseases in the Republic of Uzbekistan”) identified viral hepatitis as one of the priority areas. The following year, the Ministry of Health Decree N°542 from 27 August 2018 (“On further improvement of diagnostics, treatment and prevention of viral hepatitis in the Republic of Uzbekistan”) defined strategies to achieve viral hepatitis-related goals in Uzbekistan. A pilot program using a catalytic funding model and simplified test-and-treat strategies was implemented in Tashkent in 2019–2020. Despite challenges created by the COVID-19 pandemic, over 60,000 persons were screened for hepatitis B and C using rapid tests, approximately 1600 were diagnosed with chronic HBV infection for the first time and approximately 300 received antiviral treatment through this demonstration project [46,47]. In 2022, two presidential ordinances endorsed expansion of viral hepatitis elimination program in Uzbekistan through 2025 and allocated budget to increase HBV and HCV screening up to 1 million persons annually, establish the national electronic registry for chronic liver disease, provide antiviral treatment to HCV-infected persons, and hepatitis B vaccination to healthcare workers in contact with blood [48,49]. The finalization of the national strategic plan for viral hepatitis elimination, currently under development, will help

to identify innovative approaches to implementation of viral hepatitis elimination and ensure continued expansion of these efforts throughout Uzbekistan.

The present serosurvey had certain limitations. The narrow age range of the serosurvey limited generalizability of its findings to all age cohorts of children in Uzbekistan. However, consistently very high routine infant immunization coverage for hepatitis B over the years should have reduced the impact of this limitation. The small number of HBsAg positive children limited statistical power of the survey for this group, preventing detailed analysis of seroprevalence by sex, region, or age cohort. Immunization records were not available for all children, and, on rare occasions, the date of HepB-BD given at the maternity hospital was not transferred to the immunization card stored at the primary health care facility. However, such instances were infrequent and should not have had substantial impact on the representativeness of the immunization status of children. In addition, to reduce participation bias, we requested immunization records for all children in the selected classes, irrespective of their participation status and were able to collect immunization records for the vast majority of targeted children.

Overall, this serosurvey documented success of Uzbekistan's national immunization program and provided data in support of feasibility of the elimination of HBV in the country. The experience and lessons learned from implementing the elimination program in Uzbekistan, which has been among the first in Central Asia to undertake this initiative, will be helpful to neighboring countries, as well as other low- and middle-income countries who often encounter similar challenges.

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Data availability

The authors do not have permission to share data.

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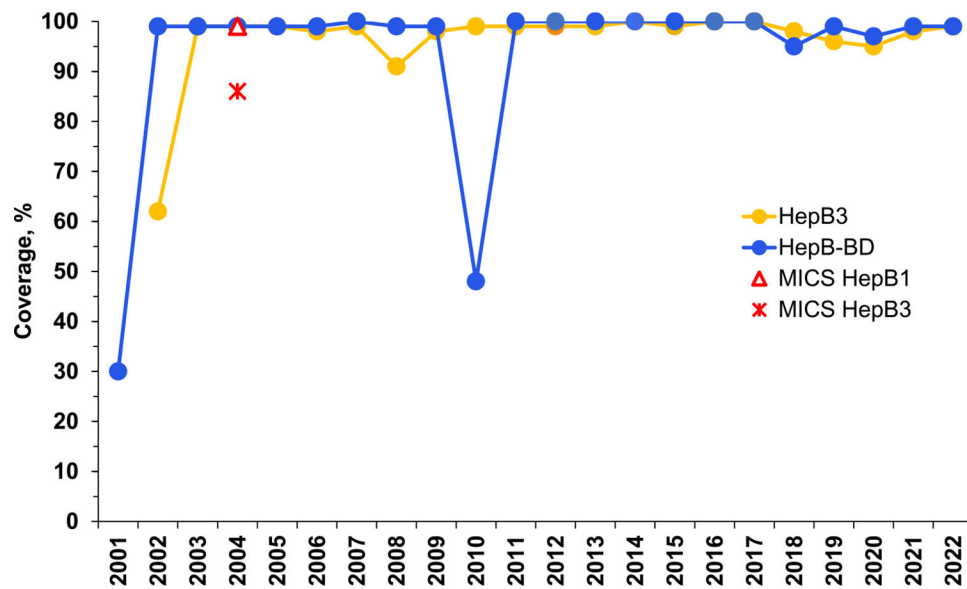


Fig. 1.

Immunization coverage with hepatitis B vaccine in Uzbekistan, 2001–2022 – birth dose (HepB-BD) and 3rd dose (HepB3).

Note: HepB3 coverage reflects coverage with hepatitis B monovalent vaccine (3 doses – birth dose plus 2 additional doses) during 2001–2008, and with a monovalent vaccine (birth dose) and pentavalent vaccine (4 doses – birth dose plus 3 additional doses) since 2009.

Sources official country reports to World Health Organization [12] and 2006 MICS [13].

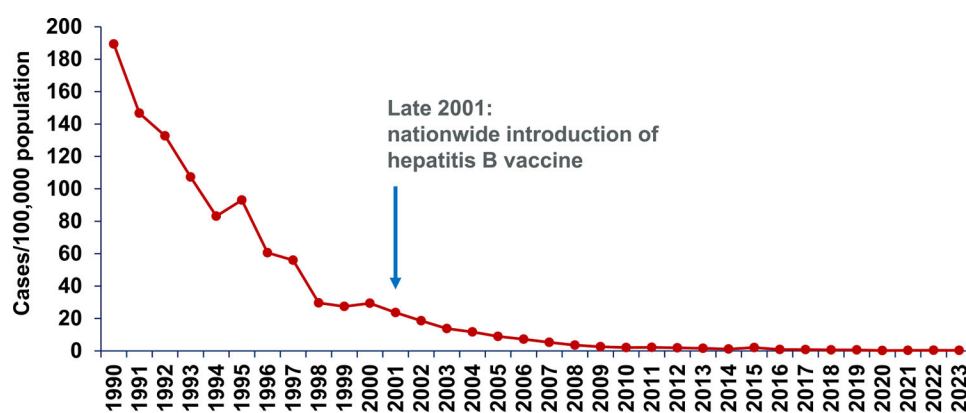


Fig. 2. Reported incidence of acute hepatitis B cases (per 100,000 population), Uzbekistan, 1990–2023.

Sampling of serosurvey participants

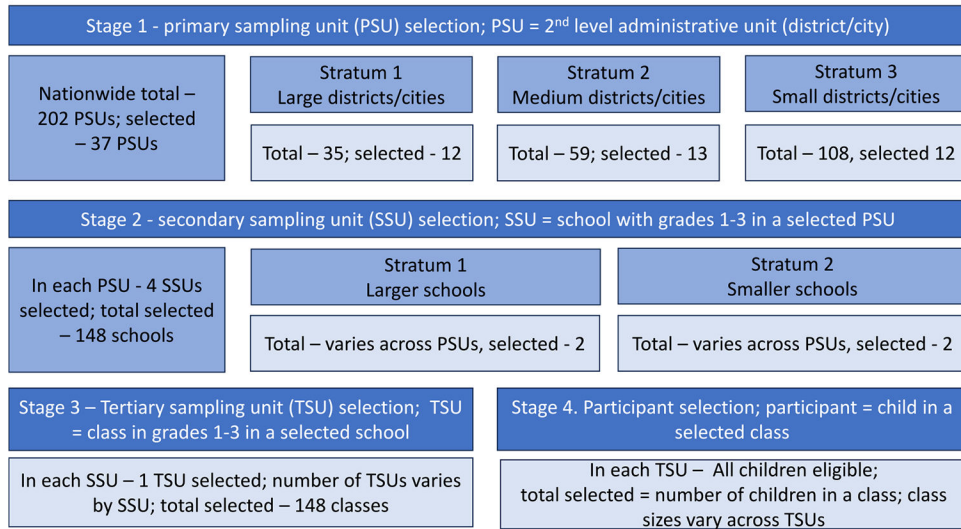
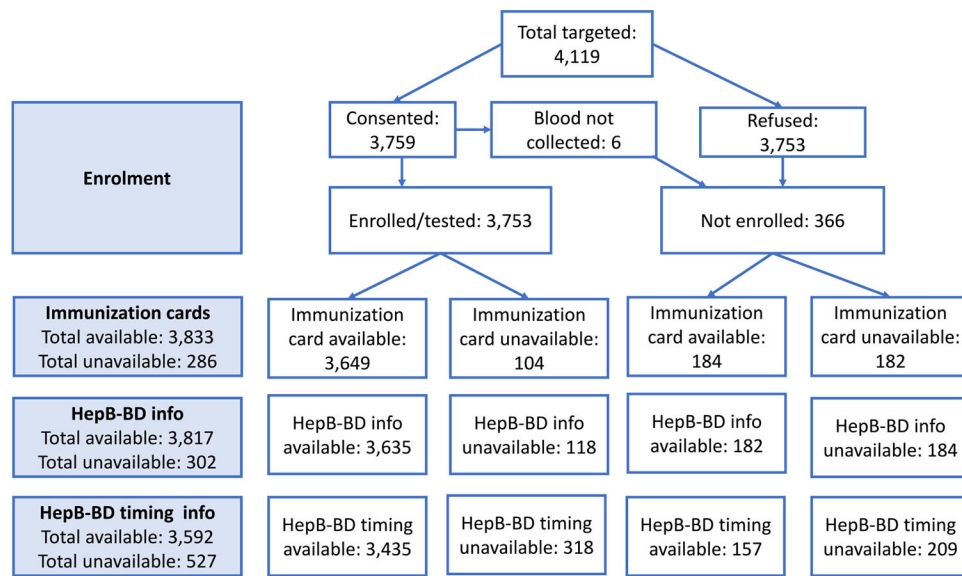


Fig. 3.
Sampling stages, nationwide hepatitis B serosurvey among schoolchildren in Uzbekistan, 2022.

**Fig. 4.**

Serosurvey enrolment and availability of immunization records, hepatitis B serosurvey among schoolchildren in Uzbekistan, 2021.

Table 1

Distribution of survey participants by region, nationwide hepatitis B serosurvey among schoolchildren in Uzbekistan, 2022.

Region	No.	Crude % of survey participants	% of total population of Uzbekistan aged < 15 years
Tashkent City	446	11.9	8
Andizhan region	300	8.0	9
Bukhara region	289	7.7	6
Jizak region	310	8.3	4
Kashkadarya region	418	11.1	10
Navoy region	88	2.3	3
Namangan region	109	2.9	8
Samarkand region	459	12.2	11
Surkhandarya region	261	7.0	8
Syrdarya region	80	2.1	2
Tashkent region	267	7.1	9
Fergana region	502	13.4	11
Khorezm region	112	3.0	5
Republic of Karakalpakstan	112	3.0	6
Total	3753	100.0	100

Table 2

Prevalence of HBsAg and hepatitis B immunization status of children, nationwide serosurvey for hepatitis B among schoolchildren, Uzbekistan, 2022.

Variables	No.	Total No. with available data	Crude %	Weighted % (adjusted 95 % CI)
HBsAg prevalence				
HBsAg-positive	6	3753	0.16	0.20 (0.09–0.38)
HBsAg-negative	3747	3753	99.84	99.80 (99.62–99.91)
HepB immunization status				
Received ≥3 doses	3745	3833	97.7	97.7 (97.2–98.1)
Received ≥1 doses	3822	3833	99.7	99.8 (99.6–99.9)
Received 0 doses	11	3833	0.3	0.2 (0.1–0.4)
Received HepB-BD	3635	3817	95.2	94.9 (94.1–95.5)
Received timely HepB-BD	3349	3592	93.2	93.7 (92.9–94.5)

CI, confidence interval; HBsAg, hepatitis B virus surface antigen; HepB, hepatitis B vaccine; HepB-BD, birth dose of hepatitis B vaccine.

Totals vary across variables because of incomplete reporting of dates of birth and vaccination; timely HepB-BD is defined as one administered within 24 h of birth.