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Original Article

Mass screening of hepatitis B and C in Burkina Faso: seroprevalence update and impact of hepatitis B vaccine

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Abstract

Introduction: Updated data on the seroprevalences of hepatitis B and C viruses (HBV, HCV) are required to enable the adaptation of control strategies. In this study, we aimed to: (i) estimate the seroprevalences of HBsAg carriers and HCV exposure in the general population, and (ii) determine the impact of vaccination on HBV circulation since its introduction in 2006 in the Expanded Program on Immunization (EPI).

Methodology: From October 2020 to October 2022, a mass screening campaign was conducted in 10 cities across Burkina Faso. Individuals of all ages and genders who consented to participate were screened for viral markers (HBsAg, anti-HCV) using rapid diagnostic tests. The proportions of HBsAg carriers and HCV exposure were calculated using Stata, and logistic regression was used to assess the impact of HBV vaccination on HBsAg carriage.

Results: A total of 15,650 participants were enrolled in the study. Of these, 51.4% were women and the age range was from 1 to 97 years. All participants were screened for HBsAg and 7,507 were also screened for anti-HCV. Overall, the seroprevalence of HBsAg was 8.8% and 2.6% for anti-HCV. The results indicated that age, gender, and place of residence were associated with HBV infection.

Conclusions: The prevalence of HBV and HCV infections remains high in Burkina Faso. Prevention strategies, including initial mass screening with rapid diagnostic tests and vaccination, need to be intensified.

Key words: Hepatitis B; hepatitis C; seroprevalence; mass screening; epidemiology; Burkina Faso.

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Introduction

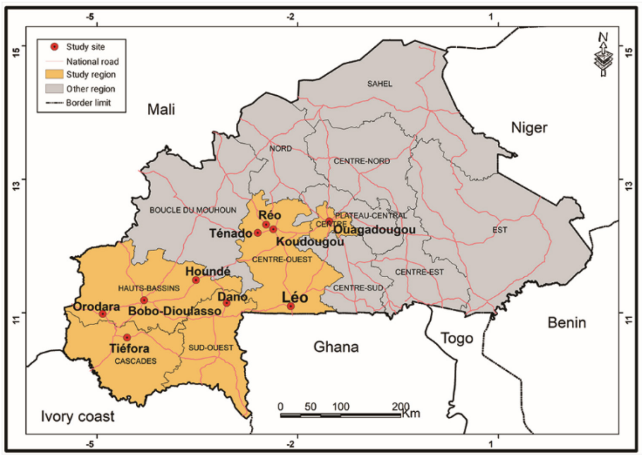
Viral hepatitis remains a major public health concern in Sub-Saharan Africa (SSA) and South-East Asia (SEA) [1]. A leading cause of death worldwide due to complications such as cirrhosis and hepatocellular carcinoma, viral hepatitis kills approximately 1.34 million people per year (about 3,000 per day). This mortality rate is comparable to that of other major infectious diseases, including human immunodeficiency virus, acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis and malaria. It is estimated that 96% of these deaths are attributable to hepatitis B virus (HBV) and hepatitis C virus (HCV) [2].

HBV is the leading cause of hepatitis worldwide, with an estimated 2 billion people infected, of whom 316 million are chronic carriers [3]. It is estimated that there are approximately three million new infections occur globally each year, and this number is expected to remain at approximately the same level until 2030 unless intensified preventive measures are implemented [4]. The SSA region is one of the most affected by the HBV epidemic, with approximately 60 million chronic carriers. Safe and effective vaccines have been available since the early 1980s [5] and are widely used in the WHO's Expanded Program on Immunization (EPI). Furthermore, vaccination has proven to be the most effective prevention method, having prevented 210 million new infections since the inception of the global immunization program [6,7].

As for hepatitis C, it is estimated that approximately 71 million individuals are chronically infected worldwide, including 11 million in Africa. Each year, approximately 1.7 million new HCV infections occur globally. Additionally, hepatitis C is responsible for an estimated 704,000 deaths worldwide annually [4,8].

In Burkina Faso, as in other countries in the SSA region, viral hepatitis is a major public health problem. The estimated prevalence of HBV infection in the general population is approximately 9% [9,10] and that of HCV exposure is approximately 4% [9,11]. However, it should be noted that the data presented in these studies are only a few years old. For instance, the findings reported by Meda and colleagues in their 2018 paper were based on samples collected in 2010 as part of the Demographic Health Survey (DHS), and thus did not include individuals under the age of 15 years. Furthermore, there is a paucity of recent studies in the general population that can provide health authorities with reliable data for the development of more effective control strategies. Consequently, the present study was designed with the following objectives: (i) to estimate the seroprevalences of HBsAg carriers and exposure to HCV in the general population, and (ii) to determine the impact of vaccination on HBV circulation since its introduction in the EPI in 2006.

Figure 1. Map showing the study sites. Source: IRSS (Health Sciences Research Institute); IGB/BNDT (2024).



Methodology

Study design

From October 2020 to October 2022, a cross-sectional study was conducted through a mass screening campaign conducted in 10 cities across six different regions of Burkina Faso. The campaign was organized by Assaut-Hépatites, a non-governmental organization (NGO) engaged in the fight against viral hepatitis. The cities included in the study were Ouagadougou, Bobo-Dioulasso, Koudougou, Léo, Réo, Dano, Ténado, Houndé, Orodara and Tiéfora (Figure 1). The cities were selected based of their geographical accessibility and the availability of a healthcare facility with qualified staff for the clinical management of positive cases. All participants who provided consent were screened for HBV and/or HCV infection markers (HBsAg, anti-HCV) using rapid diagnostic tests (RDTs) according to the manufacturer's instructions. The testing campaign was conducted in accordance with two distinct strategies. The first entailed a fixed strategy, wherein patients were directed to the Assaut-Hépatites Centre for testing. The second strategy was an advanced strategy, wherein the mobile team conducted testing in the community. Prior to the campaign's implementation in each city, the population was duly informed through a combination of the media outlets, social networks and leaflets. On the day of the campaign, individuals who wished to participate were directed to the designated location, where the mobile team was waiting to conduct screenings. An organizational structure was established to facilitate individual screening and ensure the confidentiality of results. Information such as full name, age, date of birth and gender was systematically recorded in the database to prevent duplication during screening sessions.

Study population and data collection

The study population included all individuals, regardless of age, who consented to undergo screening for hepatitis B and/or C. Children were included under the supervision of their parents or legal guardians. A data collection form was utilized to collect sociodemographic information, including such as age, gender, and place of residence for each participant. The mobile teams engaged in the advanced strategy and the

permanent staff of the Assaut-Hépatites Centre underwent training in pre- and post-test counseling, data collection form completion, and test implementation.

Screening of HBsAg and anti-HCV

HBsAg and anti-HCV were detected using one of the following RDTs: OnSite HBsAg Combo (CTK Biotech, USA) and DETERMINE HBsAg2 (Abbott Diagnostics Medical Co., Japan) were used for the detection of HBsAg, while the OnSite HBsAg/HCV Ab (CTK Biotech, USA) was utilized for the simultaneous detection of HBsAg and anti-HCV. The type of test used depended on its availability in the region during the study period. A summary of the characteristics of the tests is provided in the Table 1. These are immunochromatographic tests for the qualitative detection of HBsAg and/or anti-HCV antibodies in whole blood, serum or plasma. These tests are unitary, simple to use and can be stored at room temperature. To perform the test during the campaign, the cassettes were removed from their plastic pouches and placed on a clean, flat and dry surface. Subsequently, the tests were labeled according to the number assigned to each participant. All RDTs were performed according to the manufacturer's instructions. Approximately 50 µL of whole blood, dependent on the test utilized, was collected from the well-disinfected fingertip of each participant and transferred to the sample well via a capillary tube. A drop of migration buffer was added to the sample deposition area and the stopwatch was started. Results were read between 15 and 20 minutes after the start of the assay.

Study variables

The study variables are age, gender and residence of the participants. Following the introduction of hepatitis B vaccination as part of the EPI in 2006, all children born between 2006 and 2022 (aged 1 to 17 years) should have been exposed to the hepatitis B vaccination. Consequently, the age variable was categorized the into three modalities: under 18, 18-49, and 50 and over.

Statistical analysis

The data from all study participants were initially collected in a Microsoft Excel spreadsheet and subsequently exported to Stata version 17.0 for all statistical analyses. Descriptive statistics were utilized, with frequencies and percentages for categorical variables. Furthermore, the proportion of serological markers (in percentages) was presented as the seroprevalence of hepatitis B and C infection status. Exact 95% confidence intervals (95% CI) were calculated for the proportions.

A chi-squared analysis was employed to ascertain the existence of any discrepancies between the distributions of categorical variables. A multiple logistic regression analysis was employed to ascertain the correlation between participant age and the prevalence of HBV and HCV infection, with adjustments made for potential confounding variables, including gender and residence. In the logistic models, HBV and HCV infection were the outcome variables, while the participant age (categorical variable with three modalities) was the main independent variable. The crude odds ratio (OR) with 95% confidence intervals (CIs) and the adjusted OR with 95% CIs were calculated. A p-value of less than 0.05 was considered to indicate statistical significance. All statistical analyses were two-way and performed using Stata17.0.

Ethical approval

This mass campaign was organized by Assaut-Hépatites to promote the fight against viral hepatitis in Burkina Faso. It is recognized by the government of Burkina Faso under receipt no: N0000466401. The Organization has an agreement with the Ministry of Health, which authorizes it to conduct awareness, screening, and vaccination activities on a national scale and under the Ministry's supervision. These activities were thus conducted by duly qualified health professionals who had received training in research

Table 1. Characteristics of RDTs used for the detection of HBsAg and/or anti-HCV.

Characteristic	OnSite HBsAg Combo	DETERMINE HBsAg2	OnSite HBsAg/HCV Ab
Manufacturer	CTK Biotech	Abbott Diagnostics Medical	CTK Biotech
Storage temperature (°C)	2-30	2-30	2-30
Sample volume (µL)	50	50	50
Analytical threshold	0.5 ng/mL	0.1 IU/mL	0.5 ng/mL for HBsAg
Sensitivity	100% (95% CI: 99.2-100%)	97.9% (95% CI: 93.1-99.2%)	HBsAg: 100% anti-HCV: 99.1%
Specificity	99.9% (95% CI: 99.7-100%)	99.6% (95% CI: 98.2-100%)	HBsAg: 100% anti-HCV: 100%
Time to result (min)	15-20	15	15

ethics. Information regarding viral hepatitis and the appropriate course of action in the event of a positive or negative test result was provided to all participants. Participation in the screening sessions was voluntary, and the data obtained were kept confidential. Children were accompanied by a parent or legal guardian who acted as a guarantor. Positive cases were referred to the current management of hepatitis B and C and HIV infection in Burkina Faso. For HBsAg-negative cases, the hepatitis B vaccine was administered.

Results

Sociodemographic characteristics of study participants

A total of 15,650 participants were enrolled at the screening sites. The study population was 51.4% female and ranged in age from 1 to 97 years. People under 18 years of age represented 22.8%, while only 10.5% were at least 50 years old. The majority (70.0%) of participants were screened using an advanced strategy. With regard to the participants' place of residence, the screening activities were carried out in ten (10) cities of Burkina Faso (Ouagadougou, Bobo-Dioulasso, Koudougou, Dano, Houndé, Orodara, Léo, Réo, Tenado and Tiéfora). The majority (70.0%) of the participants resided in Bobo-Dioulasso. The characteristics of the study population are presented in Table 2.

Seroprevalence of HBsAg and anti-HCV

Table 2. Sociodemographic characteristics of study participants.

Characteristic	n	%
Gender		
Female	8051	51.4
Male	7599	48.6
Total	15650	100.0
Age group (years)		
< 18	3557	22.8
18-49	10425	66.7
≥ 50	1639	10.5
Total	15621	100.0
Type of strategy		
Advanced	10959	70.0
Set	4691	30.0
Total	15650	100.0
Residence		
Bobo-Dioulasso	11679	78.8
Dano	221	1.5
Houndé	596	4.0
Koudougou	255	1.7
Léo	294	2.0
Orodara	354	2.4
Ouagadougou	469	3.2
Réo	358	2.4
Tenado	228	1.5
Tiéfora	348	2.3
Other countries	15	0.1
Total	14817	100.0

A total of 15,650 participants were tested for HBsAg, and 7,507 participants for anti-HCV. The overall seroprevalences of HBsAg and anti-HCV were 8.8% (1379/15650; 95% CI: 8.4-9.3) and 2.6% (199/7507; CI 95%: 2.3-3.0), respectively. The distribution of HBsAg seroprevalence according to participant characteristics revealed that the highest

Table 3. Seroprevalence of HBsAg and anti-HCV by sociodemographic characteristics.

Characteristic	HBsAg				Anti-HCV			
	Total	Positive		*p*	Total	Positive		*p*
		n	%			N	%	
Age group (years)				< 0.001				< 0.001
< 18	3557	95	2.7		920	6	0.7	
18-49	10425	1156	11.1		5590	137	2.5	
≥ 50	1639	126	7.7		993	56	5.6	
Total	15621	1377	8.8		7503	199	2.7	
Gender				< 0.001				0.239
Female	8051	566	7.0		3539	102	2.9	
Male	7599	813	10.7		3968	97	2.4	
Total	15650	1379	8.8		7507	199	2.7	
Type of strategy				< 0.001				0.001
Advanced	10959	695	6.3		3704	121	3.3	
Set	4691	684	14.6		3803	78	2.1	
Total	15650	1379	8.8		7507	199	2.7	
Residence				< 0.001				< 0.001
Bobo-Dioulasso	11679	1127	9.6 (9.1-10.2)		6066	85	1.4 (1.1-1.7)	
Dano	221	46	20.8 (15.9-26.7)		221	61	27.6 (22.1-33.9)	
Houndé	596	61	10.2 (8.0-13.0)		596	19	3.2 (2.0-5.0)	
Koudougou	255	5	2.0 (0.8-4.6)		7	0	-	
Léo	294	9	3.1 (1.6-5.8)		-	-	-	
Orodara	354	26	7.3 (5.0-10.6)		340	0	-	
Ouagadougou	469	31	6.6 (4.7-9.3)		205	2	0.6 (0.1-2.3)	
Réo	358	9	2.5 (1.3-4.8)		-	-	-	
Tenado	228	8	3.5 (1.8-6.9)		-	-	-	
Tiéfora	348	37	10.6 (7.8-14.3)		205	29	14.1 (10.0-19.7)	
Other countries	15	3	20.0 (5.9-0.5)		15	0	-	
Total	14817	1362	9.2 (8.7-9.7)		7467	196	2.6 (2.3-3.0)	

-: anti-HCV test not performed.

seroprevalences were observed in men (10.7%; $p < 0.001$), in people aged 18–49 years (11.1%; $p < 0.001$) and in those screened under a fixed strategy (14.6%; $p < 0.001$). The HBsAg seroprevalence ranged from 2.0% in Koudougou located in the Centre-west of Burkina Faso to 20.0% in Dano in the south-west region (Table 3).

Significant differences in anti-HCV seroprevalence were observed between age groups ($p < 0.001$) and the type of strategy ($p < 0.001$). No statistically significant difference was observed between seroprevalence and gender ($p = 0.23$). The urban seroprevalence varied from 0.0% in Koudougou and Orodara (Haut-Bassins region) to 27.6% in Dano (Table 3).

Co-infection with HBsAg and anti-HCV was observed in 22 participants, corresponding to a seroprevalence of 0.3% (22/7507). The co-infected participants resided mainly in Bobo-Dioulasso and Dano and were aged between 19 and 60 years.

Factors associated with HBV infection status and HCV exposure

In this section, we conducted an analysis of the impact of the introduction of hepatitis B vaccination using the age of the participants. The results of the logistic regression analysis showed that participants aged 18-49 years (aOR: 3.3; 95% CI: 2.6-4.2; $p < 0.001$) and those aged 50 years and older (aOR: 2.1; 95% CI: 1.6-2.9; $p < 0.001$) had a higher risk of HBsAg positivity compared with the group aged under 18 years (those who were supposed to be vaccinated by the EPI). Similarly, HBsAg positivity was significantly associated with the male sex (aOR: 1.6; 95% CI: 1.4-1.8; $p < 0.001$) (Table 4).

In addition, multivariate analyses showed that anti-HCV seroprevalence increased significantly with age, from 2.5% in participants aged 18-49 years (aOR: 3.4; 95% CI: 1.5-7.9; $p = 0.004$) to 5.6% in those aged 50 years and older (aOR: 6.7; 95% CI: 2.8-16.1; $p < 0.001$) (Table 4). In contrast, the association between male sex and anti-HCV seropositivity was not significant (aOR: 1.0 (0.8-1.4; $p = 0.903$).

Discussion

The mass screening campaign for hepatitis B and C in the general population, conducted in multiple cities across Burkina Faso, revealed an HBsAg seroprevalence rate of 8.8%. This prevalence remains high and corroborates the endemic nature of HBV infection in Burkina Faso, as evidenced by prior studies [9, 10]. This result also highlights the need to intensify screening campaigns to allow the population to know their serologic status for early treatment of the infection and thus better control. Indeed, in areas of high endemicity of HBV infection, it is estimated that 95% of infected persons are unaware of their serologic status [2].

The prevalence of HBsAg was significantly lower in participants under the age of 18 (2.7%) than in those aged 18 – 49 (11.1%; aOR: 4.5; $p = 0.000$) and in those aged 50 years and older (7.7%; aOR: 3.0; $p = 0.000$). This finding may be indicative of the positive impact of the hepatitis B vaccine administered in Burkina Faso in 2006 as part of the EPI. The observed HBsAg seroprevalence of 2.7% in the group of participants who should have received the HBV vaccine may be attributed to either mother-to-child transmission or horizontal transmission in early childhood. The administration of hepatitis B vaccine at birth in Burkina Faso commenced in April 2022. Additionally, a positive correlation was identified between male sex and HBsAg positivity (aOR: 1.5; $p = 0.000$). This finding aligns with the results of previous studies [9,12,13] and may be associated with sex-based differences in the cellular immune responses to HBV infection [14,15]. Furthermore, a markedly elevated HBsAg seroprevalence was observed among those subjected to screening in the fixed strategy (14.6%) in comparison to those undergoing screening in the advanced strategy (6.3%). This may be attributed by the fact that a considerable proportion of individuals who sought screening at the Assaut-Hépatites Centre were already aware of their infection status and sought to be included in the care cycle. Also, the establishment of readily

Table 4. Factors associated with HBV infection and HCV exposure.

Characteristic	HBsAg				Anti-HCV			
	Crude OR (95% CI)	*p*	aOR[1] (95% CI)	*p*	Crude OR (95% CI)	*p*	aOR[1] (95% CI)	*p*
Age group (years)								
< 18	Ref[2]		Ref[2]		Ref[2]		Ref[2]	
18-49	4.5 (3.7-5.6)	<0.001	3.3 (2.6-4.2)	<0.001	3.8 (1.7-8.7)	0.001	3.4 (1.5-7.9)	0.004
≥ 50	3.0 (2.3-3.9)	<0.001	2.1 (1.6-2.9)	<0.001	9.1 (3.9-21.2)	0.000	6.7 (2.8-16.1)	0.000
Gender								
Female	Ref		Ref		Ref		Ref	
Male	1.6 (1.4-1.7)	<0.001	1.6 (1.4-1.8)	<0.001	0.8 (0.6-1.1)	0.239	1.0 (0.8-1.4)	0.903

[1] adjusted to the region where the patient lives. [2] reference value is equal to 1.

accessible testing facilities in various communities has the potential to facilitate the elimination of viral hepatitis B and C as a public health concern by 2030, through enhanced case detection. The HBsAg seroprevalence rate varied considerably across different cities in Burkina Faso. It was lowest in Koudougou located in the center-west, at 2.0%, and highest in Dano, situated in the southwest region, at 20.0%. The lowest prevalence recorded, in the cities of Koudougou (2.0%), Réo (2.5%), Léo (3.1%) and Tenado (3.5%), can be attributed to the fact that the study population consisted primarily of children under the age of 15, a factor that may be directly related to the impact of the hepatitis B vaccination. In addition, the elevated prevalence in the city of Dano may be related to ritual practices (scarification, circumcision) that could facilitate the transmission of the virus. The data from the various cities should help the health authorities in formulating a strategy to control viral hepatitis in Burkina Faso.

The overall seroprevalence of HCV exposure was 2.6%. This prevalence is comparable to that documented in previous studies of the general population [9,11], which classified Burkina Faso as an intermediate zone with respect to HCV infection [2]. However, higher seroprevalences were reported in the localities of Tiéfora (14.1%) in the Cascades region and Dano (27.6%) in the southwest region. These elevated seroprevalences were also reported by Meda and colleagues in their national HBV and HCV seroprevalence study, thereby confirming the high circulation of HCV in these regions. Further investigation is required to identify the risk factors in these localities that could facilitate the interruption of the transmission chain. The implementation of an awareness, testing and treatment program as a microelimination strategy will assist in controlling this silent epidemic.

Logistic regression analyses revealed that the risk of HCV exposure increased with age, with a significant difference observed between the 18-49 age group (aOR: 3.9, $p = 0.001$) and those aged 50 years and older (aOR: 9.2, $p = 0.000$). These findings align with those previous studies [9], underscoring the necessity for HCV screening programs to prioritize these groups, particularly in resource-limited countries.

Active hepatitis B /HCV exposure coinfection was identified in 0.3% of cases, indicated the presence of an underlying risk. Indeed, coinfection has been linked to heightened disease severity and accelerated progression to complications [16]. Consequently, it is prudent to integrate systematic testing for both viruses during screening protocols, as recommended by the WHO.

Our study has several limitations. It is important to note that the participants in this study were volunteers. Accordingly, the findings cannot be considered representative of the general population, and the prevalence may be biased. This maybe particularly pertinent given that those who underwent testing exhibited differing levels of awareness, risk perception and risk-taking compared to those who did not. Some individuals sought testing because they had learned that a family member, sibling, or spouse had tested positive. In light of these considerations, it is possible that the results may be overestimated in some locations. This is corroborated by the findings of the participants who were tested at the Assaut-Hépatites Centre (fixed strategy) in comparison with the findings of the advanced strategy. Secondly, the data collection lacked the inclusion of other pertinent variables that are associated with an elevated risk of HBsAg carriage. These variables encompass risk behaviors, such as unprotected sexual intercourse, the sharing of equipment that has been in contact with the blood of an infected individual, direct contact with the blood of an infected person, tattooing, piercing or maternal history of hepatitis B, etc.). The incorporation of these may facilitate a more accurate adjustment for the association between age and HBsAg carriage.

Conclusions

The data obtained from the implementation of this screening campaign demonstrated that hepatitis B and C continue to represent a significant public health concern in Burkina Faso. The southwest region exhibited elevated seroprevalences of HBsAg and exposure to HCV were reported in the southwest region. Furthermore, a low prevalence of HBsAg was observed in the under-18 age group, which suggests a potential positive impact of the hepatitis B vaccination program. To further reduce residual cases of transmission, prevention of mother-to-child transmission (PMTCT) strategies should be enhanced. These findings will assist the Health Authorities in adapting the current disease control strategies in Burkina Faso. Another important strategy would be the establishment of accessible screening centers in various locations. These centers would facilitate the intensification of mass screening and enable the population to ascertain their serological status, thereby facilitating the early detection of cases and the prompt management of the infection to prevent complications.

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Authors' contributions
AMS, DNZ, IMAT and ABIO conceived and designed the study. AMS, MNGO, AD, DK and EK performed laboratory investigations, acquired and curated the data. AC and AKI undertook analysis and interpretation of data. AMS, AC and ABIO wrote the original draft of the manuscript. AMS, DNZ, IMAT, AC, ABIO, AKI, MNGO, AD, DK, EK, DV, ABN, DI and DK reviewed and edited the final manuscript. All authors approved the final manuscript.

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Availability of data and materials
Data generated during this study are available from the corresponding author upon reasonable request.

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