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Transfusion Safety in Burkina Faso: Molecular and Serological Characterization of VAH and VHB and Coinfections in Blood Donors at the Regional Blood Transfusion Center of Koudougou, Nando Region

Issoufou Tao[1,2,3], Leslie Marie Eléonore Thio[1], Prosper Bado[3], Ina Marie Angèle Traore[4], Wendémi Alexis Sama[1], Nikiema Séni[1,5], Abdoul Karim Ouattara[1,6], Rebeca T. Compaore[4], Valérie J. T. E. Bazié[3,4], Tampoubila Edwige Yelemkouré[3], Alice Kiba[7], Albert T. Yonli[3], Florencia Djigma[1,3], Jacques Simpore[1,3*]

[1]Laboratory of Molecular Biology and Genetics, Joseph Ki Zerbo University, Ouagadougou, Burkina Faso
[2]Institute of Science and Technology, High Normal School, Ouagadougou, Burkina Faso
[3]Pietro Annigoni Biomolecular Research Centre (CERBA), Ouagadougou, Burkina Faso
[4]Department of Biomedicine and Public Health, Health Sciences Research Institute (IRSS), National Center for Scientific and Technological Research (CNRST), Ouagadougou, Burkina Faso
[5]Research Department, Centre National de Recherche et de Formation sur le Paludisme (CNRFP)/Institut National de Santé Publique (INSP), Ouagadougou, Burkina Faso
[6]University Center of Manga, Norbert ZONGO University, Koudougou, Burkina Faso
[7]Health Sciences Training and Research Unit, Tengandogo University Hospital Center, Joseph Ki Zerbo University, Ouagadougou, Burkina Faso
Email: *simpore93@gmail.com, tao.issoufou@gmail.com

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Abstract

Introduction: Hepatitis A virus (HAV) and hepatitis B virus (HBV) infections represent significant public health challenges in sub-Saharan Africa, including Burkina Faso. HAV is the most symptomatic viral hepatitis, while HBV is the most endemic and can lead to severe complications such as cirrhosis and hepatocellular carcinoma (HCC). HAV is an RNA virus belonging to the *Picornaviridae* family, whereas HBV is a DNA virus of the *Hepadnaviridae* family. Despite the health burden of HAV, limited data are available on its prevalence in Burkina Faso. Although more information exists on HBV, the introduction of the HBV vaccine into the Expanded Program on Immunization (EPI) and ongoing awareness campaigns necessitate regular updates on its epidemiological status. This study aimed to conduct serological and molecular PCR-based diagnosis of HAV and HBV among blood donors at the Regional Blood Trans-

fusion Center (CRTS) in Koudougou, Burkina Faso. **Methodology and Materials**: A prospective, descriptive study was conducted, involving 200 blood samples collected at the CRTS in Koudougou. Samples were transported and stored at CERBA for analysis. Serological screening for HAV IgM and IgG antibodies was performed using the HAV Flowflex™ TMTDRs assay. Hepatitis B surface antigen (HBsAg) was detected using the Hepanostika HBsAg Ultra kit (Biomérieux, Boxtel, Netherlands). Molecular diagnostics were conducted using the DNA/RNA Prep kit (Sacace, Ref. K-2-9 Biotechnologies) and the HBV Real-TM Sacace™ kit (Sacace Biotechnologies, Como, Italy), following the manufacturers' protocols. **Results**: The study population was predominantly male (90.5%), with 44% being pupils or students. The seroprevalence of HAV IgM and IgG antibodies was 13.5% and 8.5%, respectively, yielding an overall HAV seroprevalence of 22%. The seroprevalence of HBV, as indicated by HBsAg detection, was 2.5%. Molecular analysis of HAV showed no amplification, while the HBV molecular test revealed a prevalence of 4%. **Conclusion**: With an overall HAV seroprevalence (IgM + IgG) of 22%, Burkina Faso can be classified as a country with intermediate endemicity for HAV. This underscores the need for accelerated implementation of a vaccination program to mitigate HAV transmission. For HBV, Burkina Faso remains a high-endemicity zone, although our findings indicate a decline in prevalence, likely attributable to vaccination and public health interventions.

Keywords

Hepatitis A Virus (HAV), Hepatitis B Virus (HBV), Seroprevalence, İmmunoglobulin (Ig), HBsAg, Burkina Faso

1. Introduction

Viral hepatitis remains a major global public health concern, accounting for approximately 1.46 million deaths annually [1]. These infections impose a significant burden on healthcare systems due to their high prevalence and potential for severe complications, including cirrhosis and hepatocellular carcinoma [2]. The primary causative agents include hepatitis A (HAV), B (HBV), C (HCV), D (HDV), and E (HEV) viruses, with emerging pathogens such as hepatitis G virus (HGV) also under investigation. While these viruses are distributed worldwide, their prevalence varies significantly based on socioeconomic conditions, with HAV, HBV, and HCV being the most prevalent [3].

Despite their impact, many countries—particularly in resource-limited settings—lack comprehensive epidemiological data necessary for strategic planning, implementation, and evaluation of prevention programs [3]. These viruses differ in their transmission routes, immunology, and clinical outcomes [4]. HBV and HCV are primarily transmitted through blood exposure, vertical transmission, and sexual contact, whereas HAV and HEV are predominantly food- and waterborne, often leading to outbreaks in areas with poor sanitation [5] [6].

HAV, an RNA virus of the *Picornaviridae* family, is responsible for the most symptomatic acute hepatitis [7]. Globally, HAV caused 14,900 deaths in 2013, though this figure is likely underestimated due to surveillance limitations [8].

HBV, a DNA virus of the *Hepadnaviridae* family, exhibits marked regional variability in mortality, ranging from 5.7% in North America to 48.9% in sub-Saharan Africa [9]. Africa remains a high-endemicity zone, with HBV prevalence ranging from 8% to 18% [3]. In Burkina Faso, the national HBV prevalence is estimated at 8.77% [10], underscoring the need for ongoing surveillance and preventive measures, particularly in blood transfusion safety [11].

Given the paucity of recent data on HAV prevalence and the dynamic epidemiology of HBV following vaccination campaigns, this study aimed to assess the serological and molecular prevalence of HAV and HBV among blood donors in Burkina Faso. The findings will contribute to evidence-based public health strategies and reinforce transfusion safety protocols.

2. Methodology

Blood samples were collected at the Centre Regional de Transfusion Sanguine (CRTS), Koudougou, a regional branch of the Centre National de Transfusion Sanguine (CNTS), Burkina Faso's national blood service. The sample size was calculated using Schwartz's formula: $n = (t2 \times p\ (1 - p))/(e2)$, where "t" is the confidence level (1.96 for 95% confidence), p is the estimated prevalence for HVB and e is the margin of error (5%). Approximately 200 samples were obtained from both first-time and repeat donors between February and March 2022. Whole blood was collected in EDTA tubes by CRTS staff and subsequently transported to Ouagadougou for analysis at the Centre de Recherche Biomoléculaire Pietro Annigoni (CERBA) and the Laboratoire de Biologie Moléculaire et de Génétique (LABIOGENE), Université Joseph KI-ZERBO. In accordance with CNTS policy, all donations were routinely screened for HIV, hepatitis B and C, and syphilis to ensure transfusion safety.

3. Performing Viral Serologies

Blood was collected in dry tubes during donation. Serum was obtained by centrifugation and used for HAV and HBV serological screening. HBsAg was detected using the Hepanostika HBsAg Ultra kit (Biomérieux, Boxtel, Netherlands) at CERBA. HAV IgG and IgM antibodies were detected using the FLOWflex™ rapid diagnostic test (immunochromatography; specificity: 98.4%, sensitivity: 97.9%).

4. Molecular Detection Methods for HAV and HBV

4.1. Nucleic Acid Extraction

Molecular analyses were performed at the CERBA/LABIOGENE. HAV RNA was extracted from 100 µL of sample using the DNA/RNA Prep Kit (Sacace Biotechnologies, Ref K-2-9) according to the manufacturer's instructions, with positive and negative controls included in each run. HBV DNA was extracted from 100 µL

of mini-pool plasma using the Ribo-sorb Sacace™ kit (Sacace Biotechnologies, Como, Italy). PCR reactions were performed in 25 µL volumes containing 10 µL of nucleic acid extract and 15 µL of reaction mix.

4.2. Amplification

HAV RNA was amplified using the HAV Real-TM kit (Sacace Biotechnologies), which targets the 5′UTR region. RT-PCR conditions were: 95˚C for 15 s, followed by 46 cycles of 95˚C for 15 s and 60˚C for 40 s. The assay sensitivity was 20 copies/mL.

HBV DNA amplification was performed on the SaCycler-96 Real-Time PCR v7.3 (Sacace Biotechnologies) using the HBV Real-TM kit. For HBV-positive mini-pools, individual samples were subsequently analyzed with the HBV Real-TM Qual kit (Sacace Biotechnologies) following the manufacturer's protocol.

5. Results

5.1. Socio-Demographic Characteristics of the Study Population

The study population ranged in age from 18 to 58 years and comprised 181 men (90.5%) and 19 women (9.5%). Regarding occupation, 44.0% were pupils/students, 19.5% commercial employees, 11.0% farmers, and 25.5% informal sector workers (Table 1). Most participants were between 20 and 30 years of age. The mean age was 27.0 ± 5.70 years for women and 29.7 ± 8.31 years for men. By occupation, mean ages (± SD) were 33.9 ± 9.97 years (farmers), 24.9 ± 4.11 years (students), 34.3 ± 7.21 years (commercial employees), and 31.8 ± 9.12 years (informal sector workers).

Table 1. Socio-demographic characteristics of study populations.

Variable	Number	Percentage (%)
Gender		
Female	19	9.5
Male	181	90.5
Occupation		
Cultivators	22	11
Students	88	44
Traders	39	19.5
Inf Sect	51	25.5
Total	**200**	**100**

5.2. Seroprevalence of HBV, HAV IgM and HAV IgG and Co-Infections in the Study Population

The seroprevalence of HBV (HBsAg) in the study population was 2.5% (5/200). For HAV, the seroprevalence of IgM and IgG antibodies was 13.5% (27/200) and

8.5% (17/200), respectively, corresponding to an overall HAV seroprevalence of 22.0% (44/200) (Table 2).

Co-infections of HAV IgM/HBsAg and HAV IgG/HBsAg were 0% and 5.9% respectively.

Table 2. Seroprevalence of HBV, HAV IgM and HAV IgG in the study population.

Variable	Number	%
	VHB	
AgHbs –	195	97.5
AgHbs +	5	2.5
	VHA	
IgM –	173	86.5
IgM +	27	13.5
IgG –	183	91.5
IgG +	17	8.5
Total	**200**	**100**

Legend: + = positive; – = negative.

5.3. Molecular Prevalences of HAV and HBV

For HAV, extraction and amplification controls were validated; however, no viral RNA was detected in the study samples. The molecular prevalence of HBV was 4.0%, with gender-specific prevalences of 2.5% in men and 1.5% in women.

6. Discussion

The primary objective of this study was to determine the seroprevalence and molecular prevalence of HAV (IgM and IgG) and HBV among blood donors, while also assessing socio-demographic characteristics and potential co-infections.

Our study population was predominantly male (90.5%), consistent with reports by Wongjarupong *et al.* (2021) (71.7% male donors in Burkina Faso) [12] and Haeri Mazanderani *et al.* (2019) (90% male donors in South Africa) [13]. This gender imbalance may reflect physiological and social factors limiting female blood donation, including menstruation, pregnancy, and breastfeeding. Pupils and students constituted the largest occupational group (44%), reflecting their role as primary blood donors in Burkina Faso; blood supply often decreases during school holidays. The mean age of donors was 27 years for women and 29.7 years for men, comparable to 28.9 years reported by Zhou *et al.* (2023) in China [14].

The seroprevalence of HAV IgM was 13.5%, higher than the 3.3% reported by Haeri *et al.* [13] in South Africa, whereas HAV IgG prevalence was 8.5%, markedly lower than their reported 88.4%. These discrepancies may reflect differences in sample size and age distribution. In our study, IgM antibodies were detected in

13.8% of men and 10.5% of women, and IgG antibodies in 8.8% of men and 5.3% of women, differing from Traoré *et al*. [15], who reported 4.5% (women) and 3% (men) for IgM, and 18.2% (women) and 13% (men) for IgG in a smaller cohort (n = 91). The overall HAV seroprevalence was 22%, lower than the 80.7% reported in Sri Lanka [16] and 96.9% in Rwanda [17], likely due to the variations in endemicity, sanitation and hygiene conditions, socio-demographic characteristics, and age distributions of the study populations rather than the larger sample sizes in those studies (n = 1403 and 1045, respectively), suggesting comparatively lower HAV exposure in Burkina Faso.

The HBV seroprevalence in our study was 2.5%, lower than reported in Ghana in 2017 (7.5%), and previous studies in Burkina Faso: Nagalo *et al*. (2012) (13.4%) [18], Tao *et al*. (2014) (12.47%) [19], and Yooda *et al*. (2019) (8.56%) [11]. This apparent decline over time (13.4% → 12.47% → 8.56% → 2.5%) may reflect effective national HBV control efforts.

HBV infection was observed only in men (2.5%), aligning with previous findings in Burkina Faso (Nagalo *et al*., 2011): 16.06% men vs. 11.52% women; (Bisseye *et al*., 2013): 1.7% men vs. 1.1% women), possibly due to higher engagement in risk behaviors.

Conversely, some studies, such as Osei *et al*. (2017) in Ghana [20], report higher prevalence among women (14.3%) than men (6.7%). The highest HBV prevalence occurred in the 20 - 30 age group, likely reflecting increased sexual activity and lower awareness of sexually transmitted infections, consistent with Nagalo *et al*. (2011), though Osei *et al*. (2017) found the highest prevalence in donors aged 30–39.

HAV antibodies were most common among pupils and students, the youngest donors. This contrasts with studies from Türkiye (Yilmaz, 2020) [21] and Rwanda [17], where IgG prevalence was highest in older age groups (>46 years), reflecting differing patterns of exposure. The absence of HAV RNA amplification in our molecular analysis may indicate mutations in circulating strains affecting the target region of the assay.

The molecular prevalence of HBV in this study was 4%, comparable to Hennig *et al*. (2002) (4% in Germany) [22], but lower than reports from Burkina Faso by Doumbia *et al*. (2023) (11.9%) [23] and Diarra *et al*. (2018) (25.6%) [24], likely due to differences in detection methods and target populations. The overall HAV/HBV co-infection rate was 5.9%, higher than 0.8% reported by Nagu *et al*. (2008) in Tanzania [25]. Co-infection studies remain limited, underscoring the need for further research.

Overall, our findings highlight a moderate HAV exposure, a low and declining HBV prevalence, and the predominance of young male donors as key drivers of blood donation in Burkina Faso, providing valuable insights for public health interventions and blood safety programs.

This study has several limitations. First, the sample was restricted to blood donors, predominantly young males, which may not reflect the general population.

Second, the relatively small sample size may limit the generalizability of the findings, particularly for low-prevalence infections. Third, the molecular non-amplification of HAV could reflect assay limitations or viral mutations, preventing precise determination of HAV viremia. Finally, co-infection analysis was limited by the small number of positive cases, restricting statistical power for subgroup comparisons.

7. Conclusion

In conclusion, our study indicates a moderate HAV exposure (22% seroprevalence) and a low, declining HBV prevalence (2.5% seroprevalence; 4% molecular prevalence) among blood donors in Burkina Faso. Young male donors, particularly pupils and students, represent the main contributor to blood donation. The findings highlight the need for continued HBV surveillance, targeted vaccination programs, and further research on circulating HAV variants and co-infections to strengthen blood safety and public health strategies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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