Check for updates

Received: 23 April 2024 | Revised: 12 July 2024 | Accepted: 19 July 2024

DOI: 10.1002/hsr2.2287

ORIGINAL RESEARCH

Health Science Reports Open Access WILEY

Sociodemographic and clinical features related to hepatitis B virus infection among rejected blood donors in Luanda, Angola

Domingos Jandondo[1,2] | Victor Pimentel[3] | João Vigário[4] | Pedro Vienga[2] | Joana M. K. Sebastião[2] | Anabela Mateus[2] | Felícia Comandante[4] | Euclides Sacomboio[2,5] | Ana Abecasis[3] | Eunice Manico[4] | Deodete Machado[4] | Zinga David[2] | Jocelyne Neto de Vasconcelos[1] | Joana Morais[2] | Cruz S. Sebastião[1,2,3,5]

[1]Centro de Investigação em Saúde de Angola (CISA), Caxito, Angola

[2]Instituto Nacional de Investigação em Saúde (INIS), Luanda, Angola

[3]Global Health and Tropical Medicine, GHTM, Associate Laboratory in Translation and Innovation Towards Global Health, LA-REAL, Instituto de Higiene e Medicina Tropical, IHMT, Universidade NOVA de Lisboa, UNL, Lisboa, Portugal

[4]Instituto Nacional de Sangue (INS), Ministério da Saúde, Luanda, Angola

[5]Instituto de Ciências da Saúde (ICISA), Universidade Agostinho Neto (UAN), Luanda, Angola

Correspondence

Cruz S. Sebastião, Centro de Investigação em Saúde de Angola (CISA), Caxito, Angola.
Email: cruzdossantos10@gmail.com

Funding information

AREF (AREF-312-CRUZ-F-C0931); Fundação Calouste Gulbenkian (FCG), under the ENVOLVE Ciência PALOP program that funded the HITOLA project, Grant/Award Number: Number 250466; LA-REAL-LA/P/0117/2020, Grant/Award Number: LA-REAL-LA/P/0117/2020; FCT GHTM-UID/04413/2020, Grant/Award Number: GHTM-UID/04413/2020; FCT MARVEL (PTDC/SAU-PUB/4018/2021), Grant/Award Number: PTDC/SAU-PUB/4018/2021; Science and Technology Development Project (PDCT) within the scope

Abstract

Background: Hepatitis B virus (HBV) remains a public health concern. Blood donors screened for HBV surface antigen (HBsAg) along with aspartate transaminase (AST)/alanine aminotransferase (ALT) could play a key in providing safe blood products. We investigated the features related to HBV infection among rejected blood donors in Luanda, Angola.

Methods: This was a cross-sectional study conducted with 164 rejected donors. Donors were screened for HBsAg from March to May 2022. Overall, 63.4% tested positive for HBV.

Results: The mean age of the HBV-positive (29.2 ± 8.02) was lower than the HBV-negative (33.9 ± 10.0) ($p < 0.001$). Donors between 20 and 40 years (odds ratio [OR]: 2.34, $p = 0.045$), females (OR: 1.40, $p = 0.516$), residents in urbanized areas (OR: 1.23, $p = 0.530$), low educational (OR: 1.54, $p = 0.458$), unemployed (OR: 1.65, $p = 0.271$), and unmarried (OR:1.41, $p = 0.616$) might be likely to contract HBV. AST/ALT ratio was higher in HBV-infected (2.07 ± 1.42) than in HBV-uninfected (1.90 ± 1.14). About 20% of HBV-positive were classified as having acute liver disease, while 80% with chronic liver disease, based on AST/ALT ratio. Age ranged from 20 to 40 years (OR: 1.97, $p = 0.305$), females (OR: 1.61, $p = 0.557$), donors from non-urbanized (OR: 1.69, $p = 0.557$), a low educational (OR: 1.64, $p = 0.571$), and unemployed donors (OR: 1.81, $p = 0.289$) were likely to develop chronic liver disease.

Conclusions: Our findings indicated the failure of viral hepatitis control measures. Authorities should consider including HBV nucleic acid testing to ensure early identification of HBV in Angola.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.
© 2024 The Author(s). *Health Science Reports* published by Wiley Periodicals LLC.

of the MUTHIVAO project (Number 36 MESCTI/PDCT/2022), Grant/Award Number: Number 36 MESCTI/PDCT/2022

KEYWORDS
Angola, blood donors, HBsAg, HBV infection, liver damage

1 | INTRODUCTION

Blood components are used by health services around the world for the treatment of numerous clinical conditions. Therefore, the safety of blood products remains a major concern for blood collection centers, mainly due to transfusion-transmitted viruses (TTVs), such as hepatitis B virus (HBV).[1] HBV is prevalent in blood donors worldwide and constitutes a serious global public health problem, especially in low- and middle-income countries (LMICs).[2] Globally, more than two billion people, equivalent to about a third of the world population, have already been infected with HBV, of which 350 million people have developed chronic hepatitis infection.[3] Geographic regions are classified as highly endemic (8%), intermediate (2%–7%), and low endemic (<2%).[4] The African continent is an area of high HBV endemicity compared to the other geographical regions.[3]

Due to improvements in the criteria for selecting eligible donors for blood donation, the risk of transmitting viruses such as HBV has decreased significantly in recent years, even so, surveillance to estimate the risk of HBV transfusion in blood donors remains essential to monitor the safety of the blood supply as well as the impact of new screening tests, especially in areas of high HBV endemicity.[5] HBV surface antigen (HBsAg) along with HCV, HIV, and syphilis screening remains the keys biological marker used for screening blood donors for sexual transmission infections.[6,7] However, studies have shown that HBV mutations associated with structural changes in HBsAg and circulating immune complexes could negatively affect the performance of HBsAg detection, suggesting the inclusion of other biomarkers along with HBsAg although the cost and equipment requirements of these assays might limit their use in LMICs.[8–10]

The biological markers aspartate transaminase (AST) and alanine aminotransferase (ALT) as well as the ratio of the AST/ALT have always been used in clinical practice to reflect liver injury and have been associated with some human diseases, including chronic diseases and mortality.[11] Previous studies showed that serum determination of AST and ALT enzymes as well as their proportion is a clinically valuable procedure for differentiating viral hepatitis from other icteric diseases along with markers of infection, antibodies, and antigens.[12] Despite the high endemicity of HBV in Angola, few studies have been carried out for the screening of HBV infection in the asymptomatic or healthy population.[13–18] To the best of our knowledge, there is no study published assessing the determinants of HBV infections along with the clinical profile of liver function in HBV-infected individuals in Angola. In this study, we combine sociodemographic and clinical features related to HBV infection as well as the clinical progression to chronic liver disease among HBV-positive blood donors rejected for blood donation in Luanda, the capital city of Angola, to (i) avoid the TTVs, (ii) improve the safe blood products, and (iii) control the spread of HBV infection in Angola. Furthermore, this study presents the epidemiological picture of HBV and could serve to reflect the status of HBV prevention and vaccination programs in Angola.

2 | METHODS

2.1 | Study design and setting

This was a cross-sectional study that included 164 individuals who were rejected for blood donation at the Instituto Nacional de Sangue (INS), a reference health unit, located in Luanda, the capital city of Angola, between March to May 2022. The study was carried out at Centro de Investigação em Saúde de Angola (CISA), a research institution supported by the Instituto Nacional de Investigação em Saúde (INIS), also located in Luanda. The INIS is a public institution of the Angolan Ministry of Health (MoH), which develops research in the most diverse areas of health and its determinants, to contribute to the strengthening of public health policies in Angola. This study was approved by the National Ethics Committee of the Angolan MoH (nr. 39/2021) and the direction board of the INS (nr.128/GDG/INS/2022). Participants were informed about the objectives of the study and verbal consent was obtained from all enrolled even before they were considered part of the study.

2.2 | Data/sample collection and laboratory procedure

A structured questionnaire was used to collect demographic data such as age, gender, place of residence, level of education completed, occupation, and marital status. An estimated volume of 5 mL of blood sample was collected from all participants and placed in tubes containing ethylenediamine tetraacetic acid (EDTA) for serological (HBsAg) and biochemical (AST and ALT) screening. Additional screening for other sexually transmitted diseases was performed to rule out HCV, HIV, and syphilis infections. For this study, donors with a negative result for HBsAg were considered the control group, while the group with a positive result for HBsAg was considered the test group. All the serological screening was performed with the ARCHITECT PLUS i2000SR immunoassay analyzer (ARCHITECT, Abbott Laboratories) using the HBsAg QUAL II detection kit (Abbott Laboratories, Ltd) to screen for the current presence of HBsAg, while the biochemical screening was performed with the automatic biochemical analyzer Cobas C111 (Roche), using the AST (Roche) and ALT (Roche) detection kits, for evaluation of possible liver damage resulting from HBV infection. Positive and negative controls

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

were added during all laboratory procedures following the manufacturer's instructions. All laboratory processing as well as the interpretation of the results were carried out according to the manufacturer's instructions. Patients reactive to the HBsAg biomarker were classified as positive for HBV infection. For purposes of this study, the reference range for AST was considered to be 8–48 U/L while for ALT it was 7–55 U/L. Furthermore, AST/ALT ratios less than one were assigned to donors with acute or nonalcoholic liver disease, while an AST/ALT ratio greater than or equal to 1 was assigned to donors with suspected chronic liver disease, viral hepatitis, or liver toxicity.

2.3 | Statistical analysis

The analysis was conducted in SPSS version 29 (IBM SPSS Statistics). The descriptive analysis was presented as frequencies and percentages. The normal data distribution was presented as mean and standard deviation (SD). Parametric tests such as independent sample *T*-tests and one-way analysis of variance (ANOVA) were used to compare the mean values. Whenever possible, the variables were dichotomized and analyzed with the chi-square (χ^2) test and univariate logistic regression with a corresponding 95% confidence interval (CI) to predict features with a relation or an independent chance to present HBV infection or chronic liver disease. The reported *p* value is two-tailed and was deemed statistically significant when $p < 0.05$.

3 | RESULTS

3.1 | Features related to HBV infection among rejected blood donors from Luanda, Angola

The putative features related to the HBV infection among rejected blood donors from Luanda are shown in Table 1. A total of 164 rejected blood donors fulfilled the inclusion criteria and formed part of the analyses. The mean age of rejected blood donors was 30.9 ± 9.04 years, which varies from 18 to 58 years, of which the age group between 20 and 40 years was predominant with about 79% (130/164). The predominant sociodemographic features in the studied population were male donors (87.8%, 144/164), residents in urbanized areas (54.9%, 90/164), with a low educational level (92.1%, 151/164), employees (82.3%, 135/164), and unmarried (94.5%, 155/164).

Overall, the HBV positivity rate among these rejected blood donors was 63.4% (104/164). Mean age was statistically related to HBV infection with a difference of 4.67 years old ($p < 0.001$), being the mean age of the HBV-infected donors (29.2 ± 8.02 years) lower compared to the HBV-uninfected donors (33.9 ± 10.0 years). None of the demographic characteristics studied was related to HBV infection ($p > 0.05$). Despite that, we observed that blood donors aged between 20 and 40 years (83.7%, 87/104), male gender (86.5%, 90/104), donors from urbanized areas (56.7%, 59/104), donors with low education (93.3%, 97/104), donors employed in the public and/or private sector (79.8%, 83/104), and unmarried donors (95.2%, 99/104) were the most affected by HBV infection. Univariate logistic analyses showed that donors between 20 and 40 years (OR: 2.34 [95% CI: 1.02–5.34], $p = 0.045$), the male gender (OR: 1.40 [95% CI: 0.51–3.86], $p = 0.516$), residents in urbanized areas (OR: 1.23 [95% CI: 0.65–2.32], $p = 0.530$), with a low educational level (OR: 1.54 [95% CI: 0.49–4.82], $p = 0.458$), unemployed (OR: 1.65 [95% CI: 0.68–3.99], $p = 0.271$), and unmarried (OR: 1.41 [95% CI: 0.37–5.48], $p = 0.616$) were more likely to contract HBV infection compared to the other groups.

The clinical features showed that the mean AST, a marker of liver function in the generally rejected blood donors enrolled in this study, was 58.9 ± 53.6 U/L, higher than the maximum expected value established for this study, which ranged from 8 to 48 U/L. Mean AST values were higher in HBV-infected donors (59.7 ± 56.6 U/L) compared to mean values from HBV-uninfected donors (57.6 ± 48.6 U/L), with a mean difference of 2.04 U/L, although no significance was observed ($p = 0.816$). On the other hand, ALT values, another biological marker used to monitor liver function, in the generally rejected blood donors were 34.0 ± 30.2 U/L and were within the range established as the standard for this study. No difference in mean ALT values was observed between HBV negative (33.9 ± 20.4) or positive (34.0 ± 34.7) donors ($p = 0.972$). Also, no relationship between AST and ALT status and HBV infection was observed. Despite that, the mean AST/ALT ratio was higher in HBV-positive donors (2.07 ± 1.42) compared to the mean in uninfected donors (1.90 ± 1.14), although not significant ($p = 0.430$). Donors with AST/ALT ratio <1 presented 1.92 times (95% CI: 0.76–4.82) more chances of HBV infection compared to donors with an AST/ALT ratio ≥ 1.

3.2 | Features related to acute or chronic liver disease in HBV-infected blood donors

Overall, of the 104 HBV-positive donors, 21 (20.2%) had acute liver disease and 83 (79.8%) had chronic liver disease based on AST/ALT ratio, with a mean AST of 59.7 ± 56.6 U/L and ALT of 34.0 ± 34.7 U/L. The mean age of donors indicative of chronic liver disease (28.6 ± 7.51 years old) was lower compared to donors with suspicion of acute liver disease (31.8 ± 9.53 years old), although no statistical significance was observed ($p = 0.097$). Mean values of AST (41.7–68.2 U/L, $p = 0.706$) and ALT (27.7–49.1 U/L, $p = 0.240$) increased with age from under 20 to over 40 years, respectively. The chronic liver infection rate was highest in the 20–40 age group (85.5%, 71/83), being the same group that presented 1.97 times (95% CI: 0.54–7.21, $p = 0.305$) more likely to develop chronic liver disease, compared to the other groups. Suspected liver disease in the acute (90.5%, 19/21) or chronic (85.5%, 71/83) phase was higher in males. In addition, the highest average values of AST (60.1 ± 58.9) and ALT (35.0 ± 36.6) were also seen in male donors. Despite that, the female gender presents 1.61 times (95% CI: 0.33–7.80, $p = 0.557$) more likely to develop chronic

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 1 Sociodemographic and clinical features related to HBV infection among rejected blood donors from Luanda, Angola.

Independent variables	N (%)	HBV infection "HBsAg"			Univariate analysis	
		Neg (%)	Pos (%)	p Value	OR (95% CI)	p Value
Overall	164 (100)	60 (36.6)	104 (63.4)			
Demographic characteristics						
Age (years), mean ± SD	30.9 ± 9.04	33.9 ± 10.0	29.2 ± 8.02	**<0.001**		
<20	6 (3.70)	2 (3.30)	4 (3.80)	0.123	2.31 (0.36–14.7)	0.376
20–40	130 (79.3)	43 (71.7)	87 (83.7)		2.34 (1.02–5.34)	**0.045**
>40	28 (17.1)	15 (25.0)	13 (12.5)		1.00	
Gender						
Female	20 (12.2)	6 (10.0)	14 (13.5)	0.514	1.40 (0.51–3.86)	0.516
Male	144 (87.8)	54 (90.0)	90 (86.5)		1.00	
Residence area						
Nonurban	74 (45.1)	29 (48.3)	45 (43.3)	0.530	1.00	
Urban	90 (54.9)	31 (51.7)	59 (56.7)		1.23 (0.65–2.32)	0.530
Educational level						
Low	151 (92.1)	54 (90.0)	97 (93.3)	0.551	1.54 (0.49–4.82)	0.458
High	13 (7.90)	6 (10.0)	7 (6.70)		1.00	
Occupation						
Unemployed	29 (17.7)	8 (13.3)	21 (20.2)	0.267	1.65 (0.68–3.99)	0.271
Employed	135 (82.3)	52 (86.7)	83 (79.8)		1.00	
Marital status						
Unmarried	155 (94.5)	56 (93.3)	99 (95.2)	0.725	1.41 (0.37–5.48)	0.616
Married	9 (5.50)	4 (6.70)	5 (4.80)		1.00	
Clinical characteristics						
AST (UL), mean ± SD	58.9 ± 53.6	57.6 ± 48.6	59.7 ± 56.6	0.816		
Normal (8–48)	91 (55.5)	33 (55.0)	58 (55.8)	0.924	1.03 (0.54–1.96)	0.924
Abnormal	73 (44.5)	27 (45.0)	46 (44.2)		1.00	
ALT (UL), mean ± SD	34.0 ± 30.2	33.9 ± 20.4	34.0 ± 34.7	0.972		
Normal (7–55)	148 (90.2)	53 (88.3)	95 (91.3)	0.531	1.39 (0.49–3.96)	0.532
Abnormal	16 (9.80)	7 (11.7)	9 (8.70)		1.00	
AST/ALT ratio, mean ± SD	2.01 ± 1.33	1.90 ± 1.14	2.07 ± 1.42	0.430		
<1 (acute or nonalcoholic liver disease)	28 (17.1)	7 (11.7)	21 (20.2)	0.162	1.92 (0.76–4.82)	0.167
≥1 (chronic disease, viral hepatitis, or toxicity)	136 (82.9)	53 (88.3)	83 (79.8)		1.00	

Note: Bold numbers mean that the results were statistically significant for Chi-square or univariate analysis ($p < 0.05$).

Abbreviation: ALT, alanine aminotransferase; AST, aspartate transaminase; HBV, hepatitis B virus; HBsAg, HBV surface antigen; OR, odds ratio.

liver disease. Even so, no significant difference in men's or women's AST and ALT means was observed ($p > 0.05$). Suspicion of liver disease in the acute (66.7%, 14/21) or chronic (54.2%, 45/83) phase was higher in donors residing in urbanized areas. However, the highest mean values of AST (67.3 ± 77.0), ALT (37.0 ± 49.1), as well as more chances (OR: 1.69 [95% CI: 0.62–4.61], $p = 0.557$) to develop chronic liver disease were observed in donors from non-urbanized areas. Suspected acute (90.5%, 19/21) or chronic (94.0%, 78/83) liver injury was more observed in donors with a low educational level, as well as 1.64 times (95% CI: 0.30–9.12, $p = 0.571$) more likely to progress to chronic liver disease, although higher AST (111 ± 162) and ALT (38.5 ± 15.8) values were observed in donors with a high educational level. A statistically significant difference was observed between educational level and AST values, with the AST values of donors with

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

high education twice as high compared to donors with low education ($p = 0.013$). The employed donors were those who most had suspected acute (71.4%, 15/21) or chronic liver (81.9%, 68/83) disease and also to be the ones with the highest AST (61.8 ± 60.6) and ALT (34.4 ± 37.5) values. Despite that, unemployed donors were 1.81 times (95% CI: 0.60–5.45, $p = 0.289$) more likely to develop chronic liver disease than employed donors. Married and unmarried donors had the same chances of developing chronic liver disease, despite unmarried donors predominating with suspected acute (95.2%, 20/21) or chronic (95.2%, 79/83) liver injury, as well as presenting the highest values of AST (60.0 ± 57.7) and ALT (34.4 ± 35.4).

4 | DISCUSSION

HBV infections remain a major public health problem worldwide and the main factor for the development of liver cirrhosis.[3,19] To the best of our knowledge, this was the first study that combined HBV infection status based on the HBsAg marker of active infection with an evaluation of the clinical evolution and insights regarding the liver disease based on AST/ALT ratio[20] in a young population rejected for blood donation in Luanda, the capital city of Angola.

The peak prevalence of HBV infection in Africa has been estimated to be around 20%[3] while the seroprevalence of HBV in the general population of Angola has been estimated to be around 26%, higher than the average of the eight countries in Africa.[17] Recent data from an ongoing study by our research team showed that the prevalence of HBV based on HBsAg marker in blood donors is around 10% of approximately 96,000 blood donors screened between 2018 and 2022 (unpublished data). The HBV seroprevalence was observed in this study (63.4%) (Table 1), indicating to be the main cause of the rejection of blood donors in Luanda. A previous study carried out by our research team in 2018 observed an HBV positivity rate of 7.5% among HIV-positive pregnant women,[14] which was below the infection rate in Africa.[3] Previous studies carried out by Nebenzahl et al. (9.3%),[18] Vueba et al. (25.7%),[17] Peliganga et al. (22.7%),[16] and Almeida et al. (15.1%)[15] have also reported a high rate of HBV positivity for HBV in Angola using the same HBsAg biomarker used in the present study. This increase in the seroprevalence of HBV among rejected blood donors in the capital of Angola might be explained due the increase of people with high unsafe sexual activity and a low vaccination coverage rate against HBV among the young population. The result could also reflect the increase in socioeconomic inequalities, which is a crucial determinant for the increase of risk groups in the population. Indeed, the main risk groups for HBV identified in this study were young people aged 20–40 years (OR: 2.34, $p = 0.045$), females (OR: 1.40, $p = 0.516$), urbanized areas (OR: 1.23, $p = 0.530$), low level of education (OR: 1.54, $p = 0.458$), unemployed (OR: 1.65, $p = 0.271$), and unmarried (OR: 1.41, $p = 0.616$) (Table 1). These findings suggest that measures such as awareness-raising and mass vaccination campaigns to control the spread of HBV in Angola should be centered on these vulnerable groups, although little statistical power was observed.

We observed a statistically significant relationship between age and HBV infection ($p < 0.001$), with those infected (29.2 ± 8.02 years old) at a lower mean age than the uninfected (33.9 ± 10.0 years old), which could be attributed to the early onset of sexual activity, ineffective HBV vaccination programs, as well as a little awareness about practices to avoid contracting HBV infection in the young population. Previous studies have also reported a high rate of HBV infection in the young population up to 30 years old in different populations from Angola.[13–18] The females in our study were 1.4 times more likely to contract HBV (Table 1), which corresponds to the findings of Nebenzahl et al.,[18] but differs from the report of Valente et al.,[15] which showed that men have twice the rate of HBV infection compared to females in Angola. It is worth mentioning that the high number of individuals with low education, unemployed, and unmarried might contribute to young people adopting risky behaviors, including the practice of sex workers, which enhances the dissemination of HBV as well as other infectious agents that share the same transmission routes. Therefore, it is crucial to carry out more studies to understand the sociodemographic and behavioral determinants that enhance the spread of HBV and other viral infectious diseases in Angola.

No difference was observed in the mean values of AST, ALT, or AST/ALT ratio among infected and uninfected donors ($p > 0.05$), although the infected had a higher AST/ALT ratio (2.07) than the uninfected (1.90) (Table 1). This finding confirms that liver enzymes (AST, ALT, and the AST/ALT ratio) do not correlate with liver infection status, as previously reported in the previous studies.[19–21] We observed that the AST (from 42 to 68) and ALT (from 28 to 49) levels increased with increasing age among HBV-positive donors.

Based on AST/ALT ratio, about 20% and 80% of those infected with HBV had a clinical indication of acute or nonalcoholic liver disease and chronic disease or viral hepatitis, respectively (Table 2). Previous studies have shown that the AST/ALT ratio is a potential biomarker to assess health conditions and long-term mortality, especially high values of the AST/ALT ratio indicating a diagnosis of more severe liver damage or prediction of future cancer development due to viral hepatitis.[11,12,22] Anderson et al. showed that an AST/ALT ratio of more than one is highly suggestive of the presence of liver cirrhosis.[23] Based on these observations from previous studies, our findings showed that around 80% of rejected candidates due to HBV infection could be at an advanced stage of liver disease with a high chance of developing liver cirrhosis in the future,[20,24,25] suggesting the need for an urgent review of control measures, to rejected donors receive a specialized assistant in case they test positive for viral hepatitis.

It is worth highlighting that some studies have reported that the AST/ALT ratio seems to have clinical value as an insight into the diagnosis of cirrhosis but does not define the diagnosis of cirrhosis and does not effectively predict the degree of fibrosis in patients with chronic viral hepatitis.[19–21] The literature disagreement regarding the clinical utility of the AST/ALT ratio in individuals with HBV infection

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 2 Sociodemographic and clinical features related to acute or chronic liver disease in HBV-infected blood donors in Luanda, Angola.

				Liver damage status			Univariate analysis (chronic liver disease)	
Independent variables	*N* (%)	AST (UL) mean ± SD	ALT (UL) mean ± SD	Acute disease (AST/ALT Ratio < 1) (%)	Chronic disease (AST/ALT Ratio ≥ 1) (%)	*p* Value	OR (95% CI)	*p* Value
Overall	104 (100)	59.7 ± 56.6	34.0 ± 34.7	21 (20.2)	83 (79.8)			
Age (years), mean ± SD	29.2 ± 8.02	-	-	31.8 ± 9.53	28.6 ± 7.51	0.097		
<20	4 (3.80)	41.7 ± 13.3	27.7 ± 9.67	1 (4.80)	3 (3.60)	0.567	1.33 (0.10–17.1)	0.825
20–40	87 (83.7)	59.2 ± 58.5	32.1 ± 28.8	16 (76.2)	71 (85.5)		1.97 (0.54–7.21)	0.305
>40	13 (12.5)	68.2 ± 51.8	49.1 ± 64.0	4 (19.0)	9 (10.8)		1.00	
p Value		0.706	0.240					
Gender								
Female	14 (13.5)	56.7 ± 39.3	27.7 ± 18.3	2 (9.50)	12 (14.5)	0.554	1.61 (0.33–7.80)	0.557
Male	90 (86.5)	60.1 ± 58.9	35.0 ± 36.6	19 (90.5)	71 (85.5)		1.00	
p Value		0.837	0.468					
Residence area								
Nonurban	45 (43.3)	67.3 ± 77.0	37.0 ± 49.1	7 (33.3)	38 (45.8)	0.304	1.69 (0.62–4.61)	0.307
Urban	59 (56.7)	53.8 ± 33.2	31.8 ± 17.3	14 (66.7)	45 (54.2)		1.00	
p Value		0.278	0.453					
Educational level								
Low	97 (93.3)	56.0 ± 39.8	33.7 ± 35.7	19 (90.5)	78 (94.0)	0.567	1.64 (0.30–9.12)	0.571
High	7 (6.70)	111 ± 162	38.5 ± 15.8	2 (9.50)	5 (6.00)		1.00	
p Value		**0.013**	0.728					
Occupation								
Unemployed	21 (20.2)	51.0 ± 36.0	32.6 ± 21.2	6 (28.6)	15 (18.1)	0.284	1.81 (0.60–5.45)	0.289
Employed	83 (79.8)	61.8 ± 60.6	34.4 ± 37.5	15 (71.4)	68 (81.9)		1.00	
p Value		0.435	0.834					
Marital status								
Unmarried	99 (95.2)	60.0 ± 57.7	34.4 ± 35.4	20 (95.2)	79 (95.2)	0.991	1.00	
Married	5 (4.80)	52.3 ± 24.7	27.5 ± 15.3	1 (4.80)	4 (4.80)		1.01 (0.11–9.57)	0.991
p Value		0.767	0.671					

Note: Bold number means that the result was statistically significant for independent-sample *T*-tests ($p < 0.05$).
Abbreviation: ALT, alanine aminotransferase; AST, aspartate transaminase; HBV, hepatitis B virus; OR, odds ratio.

is an indication of the need for further studies, especially in terms of the population with occult HBV infection, such as blood donors. Despite this, our findings show that the evaluation of enzymes AST and ALT, as well as the AST/ALT ratio, could be useful in Angola for the timely identification of candidates with suspected advanced liver damage and with a high likelihood of developing liver cirrhosis. Furthermore, our results show that candidates infected with HBV who presented a high odd of developing liver cirrhosis or clinical progression of liver damage are donors between 20 and 40 years old (1.97 times), females (1.61 times), residents in non-urbanized areas (1.69 times), and unemployed candidates (1.81 times), although no statistical significance was observed ($p > 0.05$). Sociodemographic, clinical, and behavioral determinants related to the progression to liver cirrhosis among blood donors rejected due to viral hepatitis, such as HBV infection, are still little explored and deserve further investigation. Previous studies have shown that laboratory algorithms based on HBsAg detection leave a gap for infected HBsAg-negative donors donating blood during the window period and could

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

potentiate the spread of HBV infection through blood transfusion.[26] Therefore, due to the high endemicity of HBV in Angola, new screening strategies, including HBV nucleic acid testing (NAT) capable of detecting HBsAg-negative and anti-HBc-negative blood units donated during the initial acute HBV infection, should be quickly included in the testing algorithm for blood donors in Angola.[27] This strategy aims to strengthen current diagnostic strategies and to prevent or reduce the transmission of viruses due to blood transfusion, although we recognize that the Angolan Ministry of Health should consider the need to evaluate the cost-effectiveness of incorporating the NAT in the algorithms of the health units responsible for the treatment and blood transfusion.

There are important limitations to be considered when interpreting the results of this study. Firstly, the small sample size and the regional limitation of the study among rejected blood donors screened by HBsAg in Luanda, the capital city of Angola, could have contributed to the low statistical power of the study as well as not representing a current epidemiological picture of the HBV infection in the general population. Secondly, the rate of HBV infection could be underestimated, as other markers such as NAT, anti-HBc, and anti-HBe, able to define the time of infection and infectiousness were not screened among HBsAg positive or negative donors. Finally, the clinical profile of liver damage among HBV-positive donors was defined only with the biomarkers AST, ALT, and the AST/ALT ratio, although we recognize the existence of other serum markers and important clinical procedures that define liver damage or liver cirrhosis. Furthermore, we know that other conditions including metabolic disorders, alcohol intake, and physical exercise could affect AST and ALT values to change capable of inducing a misinterpretation of liver damage,[28] which reinforces the need for further studies including behavioral determinants as well as the screening of additional markers of liver function to help define earlier the stage of liver damage in blood donors rejected due to HBV infection. Despite the observed weaknesses, our findings provide an important contribution to a more comprehensive knowledge of HBV epidemiology and vaccination status in Angola. However, further studies should be performed to allow a better characterization of the HBV epidemiology, risk groups, and clinical profile of the HBV-infected population to reinforce ongoing strategies to control HBV infection in Angola.

In summary, HBV infection is a burden among young individuals in Luanda, the capital city of Angola. The high HBV positivity rate could indicate the failure of viral hepatitis control measures in Angola. HBV screening, awareness, and control strategies must be urgently reviewed to prevent the unprecedented spread of HBV infection in the young population. Angolan health authorities should consider including HBV nucleic acid testing along with markers of liver function to ensure early identification of donors with occult HBV infection to improve the safe blood products and control the spread of chronic HBV infection in Angola. These measures could serve to mitigate the unprecedented increase in HBV infections in young Angolans, which could result in a reduction in the shortage of blood donations. Further studies must be carried out to better understand the key determinants associated with HBV infection and progression to chronic liver disease among the HBV-infected population in Angola.

AUTHOR CONTRIBUTIONS

Domingos Jandondo: Investigation. **Victor Pimentel**: Writing—review and editing; formal analysis. **João Vigário**, **Pedro Vienga**, **Anabela Mateus**, and **Felícia Comandante**: Investigation. **Joana M. K. Sebastião**: Investigation; formal analysis. **Euclides Sacomboio**: Investigation; writing—review and editing. **Ana Abecasis**, **Eunice Manico**, **Deodete Machado**, and **Zinga David**: Project administration. **Jocelyne Neto de Vasconcelos**: Writing—review and editing; project administration. **Joana Morais**: Project administration; writing—review & editing. **Cruz S. Sebastião**: Conceptualization; data curation; formal analysis; visualization; writing—original draft; writing—review & editing; project administration; supervision; investigation; methodology; software; validation; resources; funding acquisition.

ACKNOWLEDGMENTS

The authors are grateful to all study participants. Thanks to the research team of CISA/INIS and INS for the data collection, laboratory procedure, and technical/administrative support. The present project was financially supported by the Fundação Calouste Gulbenkian (FCG), under the ENVOLVE Ciência PALOP program that funded the HITOLA project (number 250466), AREF (AREF-312-CRUZ-F-C0931), Science and Technology Development Project (PDCT) within the scope of the MUTHIVAO project (Number 36 MESCTI/PDCT/2022), FCT MARVEL (PTDC/SAU-PUB/4018/2021), FCT GHTM-UID/04413/2020 and LA-REAL-LA/P/0117/2020. The funders had no role in study design; collection, analysis, and interpretation of data; writing of the report; the decision to submit the report for publication.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors.

ETHICS STATEMENT

This study was approved by the National Ethics Committee of the Angolan MoH (nr. 39/2021) and the direction board of the INS (nr. 128/GDG/INS/2022). Participants were informed about the objectives of the study and verbal consent was obtained from all enrolled even before they were considered part of the study.

TRANSPARENCY STATEMENT

The lead author Cruz S. Sebastião affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

ORCID

Victor Pimentel http://orcid.org/0000-0001-6390-4128
Euclides Sacomboio http://orcid.org/0000-0002-2341-9133
Jocelyne Neto de Vasconcelos http://orcid.org/0000-0002-7318-693X
Joana Morais http://orcid.org/0000-0002-4524-4055
Cruz S. Sebastião http://orcid.org/0000-0003-1232-0119

REFERENCES

1. The Lancet. Improving blood safety worldwide. *Lancet*. 2007;370 (9585):361.
2. Bihl F, Castelli D, Marincola F, Dodd RY, Brander C. Transfusion-transmitted infections. *J Transl Med*. 2007;5(1):25.
3. André F. Hepatitis B epidemiology in Asia, the Middle East and Africa. *Vaccine*. 2000;18:S20-S22.
4. World Health Organization, Department of Essential Health Technologies. *Hepatitis B Surface Antigen Assays: Operational Characteristics (Phase I)*. Report 2. 2004.
5. Grubyte S, Urboniene J, Nedzinskiene L, et al. Prevalence, incidence and residual risk of transfusion transmitted viruses (HBV, HCV and HIV infections) in Lithuanian blood donors from 2004 to 2018: the incidence/window-period model study. *PLoS One*. 2021;16(2):e0246704.
6. Seck M, Dièye B, Guèye YB, et al. Évaluation de l'efficacité de la sélection médicale des donneurs de sang dans la prévention des agents infectieux. *Transfus Clin Biol*. 2016;23(2):98-102.
7. Luban NL, Jubran RF. The transfusion-transmitted viruses in blood transfusion. *Adv Exp Med Biol*. 2001;489:1-12.
8. Weber B. Genetic variability of the S gene of hepatitis B virus: clinical and diagnostic impact. *J Clin Virol*. 2005;32(2):102-112.
9. Thibault V, Servant-Delmas A, Ly TD, Roque-Afonso A-M, Laperche S. Performance of HBsAg quantification assays for detection of hepatitis B virus genotypes and diagnostic escape-variants in clinical samples. *J Clin Virol*. 2017;89:14-21.
10. Bloch EM, Vermeulen M, Murphy E. Blood transfusion safety in Africa: a literature review of infectious disease and organizational challenges. *Transfus Med Rev*. 2012;26(2):164-180.
11. Chen W, Wang W, Zhou L, et al. Elevated AST/ALT ratio is associated with all-cause mortality and cancer incidents. *J Clin Lab Anal*. 2022;36(5):e24356. doi:10.1002/jcla.24356
12. De Ritis F, Coltorti M, Giusti G. An enzymic test for the diagnosis of viral hepatitis: the transaminase serum activities. *Clin Chim Acta*. 2006;369(2):148-152.
13. INEM. *Inquérito de Indicadores Múltiplos e de Saúde (IIMS)—2015-2016*. 2017:1-559.
14. Sebastião CS, Neto Z, Jandondo D, Mirandela M, Morais J, Brito M. HIV, hepatitis B virus, hepatitis C virus, and syphilis among pregnant women attending antenatal care in Luanda, Angola: seroprevalence and risk factors. *J Med Virol*. 2020;92 (12):3265-3270.
15. Valente F, Lago BV, Castro CAV, Almeida AJ, Gomes SA, Soares CC. Epidemiology and molecular characterization of hepatitis B virus in Luanda, Angola. *Mem Inst Oswaldo Cruz*. 2010;105(8):970-977.
16. Peliganga LB, Horta MAP, Lewis-Ximenez LL. Enduring challenges despite progress in preventing mother-to-child transmission of hepatitis B virus in Angola. *Pathogens*. 2022;11(2):225.
17. Vueba AN, Almendra R, Santana P, Faria C, do Céu Sousa M. Prevalence of HIV and hepatitis B virus among pregnant women in Luanda (Angola): geospatial distribution and its association with socio-demographic and clinical-obstetric determinants. *Virol J*. 2021;18(1):239.
18. Guimarães Nebenzahl H, Lopes Â, Castro R, Pereira F. Prevalence of human immunodeficiency virus, hepatitis C virus, hepatitis B virus and syphilis among individuals attending anonymous testing for HIV in Luanda, Angola. *S Afr Med J*. 2013;103(3):186.
19. Eminler AT, Ayyildiz T, Irak K, et al. AST/ALT ratio is not useful in predicting the degree of fibrosis in chronic viral hepatitis patients. *Eur J Gastroenterol Hepatol*. 2015;27(12):1361-1366.
20. Nyblom H, Björnsson E, Simrén M, Aldenborg F, Almer S, Olsson R. The AST/ALT ratio as an indicator of cirrhosis in patients with PBC. *Liver Int*. 2006;26(7):840-845.
21. Reedy DW, Loo AT, Levine RA. AST/ALT ratio > or = 1 is not diagnostic of cirrhosis in patients with chronic hepatitis C. *Dig Dis Sci*. 1998;43(9):2156-2159.
22. Gurung R, Purbe B, Gyawali P, Risal P. The ratio of aspartate aminotransferase to alanine aminotransferase (AST/ALT): the correlation of value with underlying severity of alcoholic liver disease. *Kathmandu Univ Med J*. 2015;11(3):233-236.
23. Anderson F. An assessment of the clinical utility of serum ALT and AST in chronic hepatitis C. *Hepatol Res*. 2000;18(1):63-71.
24. Park G, Jones DB, Katelaris P. Value of AST/ALT ratio as fibrotic predictor in chronic hepatitis C. *Am J Gastroenterol*. 2005;100(7): 1623-1624.
25. Sheth SG, Flamm SL, Gordon FD, Chopra S. AST/ALT ratio predicts cirrhosis in patients with chronic hepatitis C virus infection. *Am J Gastroenterol*. 1998;93(1):44-48.
26. Kuhns MC, Busch MP. New strategies for blood donor screening for hepatitis B virus. *Mol Diagn Ther*. 2006;10(2):77-91.
27. Busch MP. Should HBV DNA NAT replace HBsAg and/or anti-HBc screening of blood donors? *Transfus Clin Biol*. 2004;11(1):26-32.
28. Ma W, Hu W, Liu Y, He L. Association between ALT/AST and muscle mass in patients with type 2 diabetes mellitus. *Mediators Inflamm*. 2022;2022:1-6.

How to cite this article: Jandondo D, Pimentel V, Vigário J, et al. Sociodemographic and clinical features related to hepatitis B virus infection among rejected blood donors in Luanda, Angola. *Health Sci Rep*. 2024;7:e2287. doi:10.1002/hsr2.2287

23988835, 2024, 8, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/hsr2.2287 by Universidade Nova De Lisboa, Wiley Online Library on [23/09/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License