

# Hepatitis B in Senegalese Blood Donors: Low Prevalence after Five Blood Donations?

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## Abstract

**Background:** Over the past two decades, blood transfusion safety has made significant advances in the fight against infectious diseases. However, hepatitis B is still a problem in blood banks due to its high endemicity in Senegal. In this context, we proposed to first determine the prevalence of HBs antigen (HBsAg) in regular and new blood donors. Second, to determine the influence of the number of blood donations on the prevalence of hepatitis B. **Materials and Method:** We conducted a retrospective transversal study using data from all blood donations received at the Principal Hospital of Dakar Blood bank from July 2007 to December 31, 2021. Hepatitis B testing was carried out with Automaton E411 (Roche Diagnostics). For all donors, information on age, sex, hepatitis B serology, and the number of donations was collected through the lab's computer system. Data entry and statistical analysis were performed with Epi-info version 7. **Results:** HBsAg carriers were identified in 4311 primary donors, corresponding to a prevalence of 12.39% (IC 95% = 12.04 - 12.74). The prevalence of the HBsAg antigen was higher in men (12.9%) than in women (6.85%). Men are twice as likely to be infected with HBV as women (OR = 2.00 (IC 95% = 1.85 - 2.17)). The highest prevalence (12.4%) was found in young adults (23 - 29) years old. After 10 donations, the prevalence of the HBs antigen was stable at around 1%. Individuals with a single blood donation and individuals with 2 to 5 blood donations are 9 and 7 times more likely to carry the HBs antigen than regular donors (more than 10 blood donations), respectively. **Conclusion:** Our results demon-

strate the endemic nature of hepatitis B in Senegal. On the other hand, the non-negligible prevalence of the virus in first-time donors reminds us of the need for continuous improvement in donor selection. These first-time donors, particularly young adults, are important indicators of transmission of the virus to the general population. This study also demonstrates the need to develop strategies to maintain the pool of regular donors, which represent significant barriers to the spread of hepatitis B.

## Keywords

First-Time Donor, Regular Donor, Hepatitis B, Prevalence

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## 1. Introduction

Over the past two decades, the safety of blood transfusions has made significant progress in the fight against infectious diseases and immunological risks. In Senegal, hepatitis B is the main risk, infecting 11% - 15% of adults. HBV infection is a major cause of liver disease and the most important risk factor for liver cancer. The WHO strongly recommends the collection of blood from regular, volunteer, and unpaid donors from low-risk populations [1] [2]. Several studies, including those of Zimbabwe's Tonderai Mapako, have demonstrated that the probability of finding infection is lower in a regular donor than in a primary donor. However, regular donors do not cover the increasing need for blood in response to various medical and surgical emergencies. The single donor, voluntary or substitute, is a very common alternative in recruiting blood bank donors. This risk is also exacerbated by high endemic HBV infection, with 85% of the overall population having at least one HBV marker [3]. In Senegal, few studies have focused on the characterization of HB antigen carriers in both new and regular donors. This characterization, even if carried out, does not sufficiently highlight simple and accessible parameters such as age, gender, and the number of donations. These characteristics are fundamental elements that must be taken into account when combating the transmission of the hepatitis B virus. For all these reasons, we proposed to first study the prevalence of HBs antigen (HBsAg) among regular and new blood donors in the main hospital of Dakar. Second, to determine the influence of the number of blood donations on the prevalence of hepatitis B in blood donors. The prevalence of hepatitis B in these different blood donor groups helps assess the risk of transfusion infection and the extent of hepatitis B endemicity in the general population.

## 2. Method

### 2.1. Study Area Description

The blood bank at the Principal Hospital of Dakar (HPD) is located in the Dakar Plateau district in Senegal. Principal Hospital of Dakar (HPD) is a public health

facility with military status. It is a Level 3 hospital with 471 beds and an independent blood bank for patient care (**Figure 1**).

## 2.2. Study Design

We conducted a retrospective transversal study using data from all blood donations received at the Principal Hospital of Dakar Blood bank from July 2007 to December 31, 2021. Donors fill out a form that includes information to assess the health risk of the donation to the donor and the prospective patient. People at high risk for infectious transmission (sexual activity, transfusions...) and vulnerable persons (pregnant women, breastfeeding, diabetics...) were not eligible for blood donation. One 450 mL blood bag and two 5 mL tubes were collected for serological testing in individuals who met the donation criteria. Excluded candidates were given a simple infection test. Hepatitis B testing was carried out with Automaton E411 (Roche Diagnostics). The tests were carried out using an immunological technique based on the principle of chemiluminescence of the collected human serums.

## 2.3. Study Population

The study population consisted of two categories of donors depending on the donor site.

Collection in Principal Hospital of Dakar blood bank

- Donors who came to the blood bank voluntarily without payment to donate blood to someone they do not know.
- Donors who came to the blood bank for the benefit of a sick relative in the hospital or other medical institution

Collection outside Principal Hospital of Dakar blood bank

- Donors are recruited from external collections from military camps or charitable activities.



**Figure 1.** The Dakar Hopital Principal (HPD).

## 2.4. Data Collection and Analysis

For all donors, information on age, sex, hepatitis B serology, and the number of donations was collected through the lab's computer system. Data entry and statistical analysis were performed with Epi-info version 7. Results were reported as mean and standard deviation (SD) or median in an interquartile range for quantitative variables. Whereas for categorized variables, the number and percentage of subjects in each category were computed. Prevalence's was given with a 95% confidence interval (IC 95%). Outcome variables were HBsAg (HBs antigen) positive or negative serostatus. Cross-tabulations were created from the outcome variables and the socio-demographic variables (age, gender, hepatitis B serology, number of donations). Chi-square or Fisher's exact test was used as a statistical significance test to compare sociodemographic variables with HBs antigen seropositivity. A p-value < 0.05 from two-tailed tests was considered significant in all tests. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to determine associations between sociodemographic variables and seropositive status for HBs antigen.

## 2.5. Inclusion and Exclusion Criteria

### 2.5.1. Inclusion Criteria

All donors were recruited during the study period. After the validation of the questionnaire and the preliminary medical examination, a donor will be recruited. Donors must meet the following non-exhaustive eligibility criteria set out below.

- Age between 16 and 65 years.
- Haemoglobin—not less than 12.5 g/Dl.
- Pulse - normal with no irregularities.
- Blood Pressure—Normal.
- Temperature—Normal.
- Body weight—not less than 45 Kg.
- Past six months—not had a tattoo, ear or skin piercing or acupuncture, not received blood or blood products, no serious illness or major surgery, no contact with a person with hepatitis or yellow jaundice...
- Past three months—not donated blood or been treated for Malaria.
- Past one month—had any immunizations.
- Past 48 hours—taken any antibiotics or any other medications.
- Past 24 hours—taken alcoholic beverages.
- Past 72 hours—had dental work or taken Aspirin.
- Present—not suffering from cough, influenza or sore throat, common cold.
- Women should not be pregnant or breast feeding her child.
- Women donor should not donate during her menstrual cycles.
- Free from Diabetes, not suffering from chest pain, heart disease or high BP, cancer, blood clotting problem or blood disease, unexplained fever, weight loss, fatigue, night sweats etc.

### 2.5.2. Exclusion Criteria

Donors whose medical records were not traceable were excluded from the study.

### 2.6. HBs Antigen Screening

Two 5 mL tubes were collected for serological testing from individuals who met the donation criteria. Excluded candidates were given a simple infection test. Hepatitis B testing was carried out with Automaton E411 (Roche Diagnostics). The tests were carried out using an immunological technique based on the principle of chemiluminescence of the collected human serums.

## 3. Results

### 3.1. Blood Donor Population

A total of 45,939 blood donors were registered, of which 32,269 (70%) were male and 13,670 (30%) female, which corresponds to a gender ratio of 2.33. The youngest donor was 16 years old compared to 65 years for the oldest donor. The donors had a mean and median age of 32 and 29 years, respectively. The population is young, with 53% of donors under the age of 30. The majority of the population, 39,099 (85%), were at their first blood donation, followed by blood donation group 2 - 5, which made up 12% of the people. The remaining population of regular donors is less than 3% of donors. The characteristics of the study population are summarized in **Table 1**.

### 3.2. First-Time Blood Donor Population and Hepatitis B Carriage

HBsAg carriers were identified in 4311 primary donors, corresponding to a prevalence of 12.39% (IC 95% = 12.04 - 12.74). The prevalence of the HBsAg antigen was higher in men (12.9%) than in women (6.85%). Men are twice as likely

**Table 1.** Characteristics of the study population.

Characteristic	1_donation, N = 39,099 <sup>1</sup>	2 - 5 donations, N = 5,523 <sup>1</sup>	5 - 10 donations, N = 645 <sup>1</sup>	10 - 20 donations, N = 396 <sup>1</sup>	20 - 30 donations, N = 170 <sup>1</sup>	Over_30_ donations, N = 106 <sup>1</sup>	p-value <sup>b</sup>
<b>Age<sup>a</sup></b>	28 (22, 38)	33 (25, 44)	44 (34, 53)	47 (38, 57)	50 (42, 57)	48 (43, 55)	<0.001
<b>age category</b>							<0.001
16 - 23	12,870 (33%)	1004 (18%)	17 (2.6%)	3 (0.8%)	0 (0%)	1 (0.9%)	
23 - 29	9015 (23%)	1250 (23%)	70 (11%)	36 (9.1%)	3 (1.8%)	3 (2.8%)	
29 - 39	8550 (22%)	1397 (25%)	165 (26%)	72 (18%)	31 (18%)	13 (12%)	
39 - 65	8664 (22%)	1872 (34%)	393 (61%)	285 (72%)	136 (80%)	89 (84%)	
<b>Gender</b>							<0.001
Female	11,933 (31%)	1455 (26%)	177 (27%)	78 (20%)	18 (11%)	9 (8.5%)	
Male	27,166 (69%)	4068 (74%)	468 (73%)	318 (80%)	152 (89%)	97 (92%)	

a. 1 Median (IQR); n (%); b. 2 Kruskal-Wallis rank sum test; Pearson's Chi-squared test.

to be infected with HBV as women (OR = 2.00 (IC 95% = 1.85 - 2.17)). The 39 to 65 age group has the lowest prevalence at 8.73%. The highest prevalence (12.4%) was found in young adults (23 - 29). Compared to the 39 - 65 age group, the risk is higher for 23 - 29 years old, 29 - 39 years old, and 16 - 23 years old with respective ratios of 1.49, 1, 40, and 1.30. The characteristics of HBV carriers are summarized in **Table 2**.

### 3.3. Impact of Blood Donation Number on the Prevalence

The presence of HBs antigen decreased based on the number of blood donations performed with 11.0%, 8.82% of the HBs seroprevalence for the 1-donation and 2 - 5-donation groups, respectively. After 10 donations, the prevalence of the HBs antigen was stable at around 1%. Individuals with a single blood donation and individuals with 2 to 5 blood donations are 9 and 7 times more likely, respectively, to be carriers of the HBs antigen than regular donors (more than 10 blood donations).

## 4. Discussion

### 4.1. Hepatitis B Prevalence

The results of our study confirm the endemic nature of HBV infection in Senegal, consistent with previous studies [4] since 12.39% (IC 95% = 12.04 - 12.74) of donors were positive for HBs antigen. Our results are similar to those of Macoura *et al.*, who found an HBs antigen prevalence of 12.67% in 163,787 donors

**Table 2.** Characteristics of first-time blood donor.

	[ALL] N = 39,099	Negative N = 34,788	Positive N = 4311	OR	p. ratio	p. overall
Age, Mean (SD)	31.0 [30.8; 31.1]	31.1 [31.0; 31.2]	30.0 [29.7; 30.3]	0.99 [0.99; 0.99]	<0.001	<0.001
Age category, N (%):						<0.001
16 - 23	32.9% [100.0%; 100%]	88.9% [88.4%; 89.5%]	11.1% [10.5%; 11.6%]	1.30 [1.19; 1.43]	<0.001	
23 - 29	23.1% [100.0%; 100%]	87.6% [86.9%; 88.2%]	12.4% [11.8%; 13.1%]	1.49 [1.35; 1.64]	<0.001	
29 - 39	21.9% [100.0%; 100%]	88.2% [87.5%; 88.9%]	11.8% [11.1%; 12.5%]	1.40 [1.27; 1.55]	<0.001	
39 - 65	22.2% [100.0%; 100%]	91.3% [90.7%; 91.9%]	8.73% [8.14%; 9.34%]	Ref.	Ref.	
Gender, N (%):						<0.001
Female	30.5% [100.0%; 100%]	93.1% [92.7%; 93.6%]	6.85% [6.41%; 7.32%]	Ref.	Ref.	
Male	69.5% [100.0%; 100%]	87.1% [86.7%; 87.5%]	12.9% [12.5%; 13.3%]	2.00 [1.85; 2.17]	0.000	

in a study evaluating test performance at the National Blood Transfusion Center in Dakar [3]. This prevalence is consistent with the results of Apata *et al.*, who reported a slightly increased prevalence of approximately 11% (10.50% in 2004 and 10.51% in 2010) among Senegalese blood donors in the Global Database for Blood Safety [5]. A similar prevalence of 11.7% was reported in 2003 among 3001 blood donors recruited in 7 blood centers in Senegal [6]. In the Ziguinchor blood bank, a prevalence of 10.5% was found in a population of 2613 blood donors [7]. Overall, the seroprevalence of hepatitis B antigen in Senegalese blood donors varies slightly around 11% across studies. Results vary greatly in neighboring countries with prevalences often higher than 10%. The highest rates are found in Mauritania (20.3%) [8], Guinea Conakry (16.4%) [9], Niger (15.4%) [10], Mali (13.9%) [11], Burkina Faso (13.4%) [12]. Intermediate values similar to ours are found in Cameroon (12.6%) [13], Ivory Coast (12.5%) [14], DR Congo (9.2%) [14]. Factors that may explain this variability include the predominant mode of virus transmission (vertical or horizontal) and the sociodemographic characteristics of the blood donor population. The mode of transmission also explains the low prevalence in North Africa and industrialized countries, where hepatitis has generally occurred in adulthood. In these northern countries, the prevalence is generally below 5%; 1.34% in Morocco [15], 4.3% in Egypt [16], 0.0069% in Italy [17] and 0.007% in Canada. Interestingly, we found that individuals aged 23 - 29 years had a higher HBs antigen prevalence (12.4%) than other groups. Almost a quarter of our donor population (23%) consists of people in the 23 - 29 age group. They are typically young adults in their prime and are more likely to donate blood. The similar age group of 18 - 28 years had the highest prevalence rates in a study of blood donors in Ziguinchor, a region of Senegal [7]. This group is considered by several authors to be most at risk for HBs antigen seropositivity due to the addition of sexual risk factors [18]. Several studies have focused on sexual risk, particularly in Ethiopia, where 3/4 of the Jimma Blood Bank volunteer donors who tested positive were under the age of 40. In the same study, the rate of test positivity was slightly higher among the unmarried than among the married study participants [19]. In China, the prevalence pattern for Hepatitis B is different, the highest prevalence was found in the youngest age group (1825 years) in the Zhen Wang study [20]. Similar results have been—in young adults in China, Ghana, and Gabon, where the prevalence of HBsAg in both sexes tends to increase with age in both sexes, peaking around age 40. In our study, the prevalence of the HBs antigen subsequently drops to 7.46% in 39 to 65 years old. The general decrease in the prevalence of HBsAg beyond 40 years of age has already been reported [21]. For some authors, this decrease would be related to the elimination of the virus in most elderly subjects. The other interesting fact of our study is the low prevalence rate observed in female donors with a prevalence of 6.60% versus 12.1% in males. This higher prevalence in male donors has been reported by several authors [17] [22] [23] [24] including Getinet Ayano *et al.* in a meta-analysis [25]. The mechanism of gender

disparity in the onset and progression of hepatitis virus infection is believed to be partly related to the more synergistic effect of female sex hormones on the immune response. Female donors appear to be much safer than males against HBV and should be encouraged to donate.

#### 4.2. Impact of Blood Donation Number

Our results also show that the prevalence decreases with the number of blood donations. The prevalence of HBV is 11% and 8.8% in people with 1 donation and 2 - 5 donations, respectively. The prevalence after 5 donations is in the 1% range (see **Table 3**), indicating the rarity of hepatitis B occurrence in regular blood donors. This phenomenon was observed in several countries: China [20], and Brazil [26], where the HBV prevalence in first-time donors was significantly higher than in repeat donors. The HBsAg prevalence in repeat donors was low and stable, reflecting the rare case of new infections occurring between blood donations. Individuals with a single blood donation and those with 2 to 5 blood donations are 9 and 7 times more likely to be carriers of the HBs antigen than normal donors (more than 10 blood donations), respectively. The fact that regular donors have lower HBs antigen levels can be explained by several factors. The first reason is that the majority of donors who donated more than 5 (61%) are in the 39 to 65 age group. It is common knowledge that most donors at this age are already infected with the virus and have recovered from hepatitis B disease. The second reason is that donors over the age of 40 are more mature and less likely to engage in risk-take behaviors that can lead to sexual infections. The last point is that people who donated more than five times have already been screened multiple times. Repeat blood donors are therefore less at risk than new donors who never go through the screening process. Similar results confirm that first-time donors have higher hepatitis B infection rates compared to regular and repeat blood donors [27] [28].

**Table 3.** HBs antigen prevalence and blood donation.

	HBs Ag negative N = 41,124	HBsAg Positive N = 4815	OR	p. ratio	p-value <sup>2</sup>	N
Donation group, N (%):					<0.001	45,939
1_donation	34,788 (89.0%)	4311 (11.0%)	8.97 [4.94; 18.8]	0.000		
2 - 5 donations	5036 (91.2%)	487 (8.82%)	7.00 [3.83; 14.8]	<0.001		
5 - 10 donations	637 (98.8%)	8 (1.24%)	0.93 [0.34; 2.47]	0.879		
10_donations	663 (98.7%)	9 (1.34%)	Ref.	Ref.		



## 5. Conclusion

Our results demonstrate the endemic nature of hepatitis B in Senegal. On the other hand, the non-negligible prevalence of the virus in first-time donors reminds us of the need for continuous improvement in donor selection. These first-time donors, particularly young adults, are important indicators of transmission of the virus to the general population. This study also demonstrates the need to develop strategies to maintain the pool of regular donors, which represent significant barriers to the spread of hepatitis B.

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## Authors' Contributions

All authors were involved in data collection and the preparation of the final manuscript

## Conflicts of Interest

The authors declare that they have no competing interests.

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## List of Abbreviations

HBsAg: Hepatitis B surface Antigen; HPD: Principal Hospital of Dakar; WHO: World Health Organization