International Journal of Health Sciences and Research
Vol.10; Issue: 2; February 2020
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Seroprevalence and Determinants of Hepatitis B among Blood Donors in the University Clinics of Kinshasa (2003-2006, 2008- 2013)

Blaise Matondo Manzambi Sumbu[1], Benjamin Longo-Mbenza[1,2,4], Aliocha Nkodila Natuhoyila[4,7], Mireille Nganga Nkanga[1], Jérémie Muwonga Masidi[1], Hortense Mbumba Maphana[3], Donatien Kayembe Nzongola-Nkasu[1], Georges Mvumbi Lelo[1], Hyppolite Situakibanza NT[1], Ferdinand Mbayo Kalumbu[1], Hervé Alex Tukadila Kabangi[4], , Raphael Taty Taty[5], Moulay Mustapha Ennaji[6], Steve Ahuka-Mundeke[1,2]

[1]University of Kinshasa, Kinshasa, DR Congo
[2]National Institute of Biomedical Research (INRB), Kinshasa
[3]Target Sprl.
[4]Lomo University of research, Kinshasa, Democratic republic of Congo,
[5]Faculty of Health Sciences, Marien Ngouabi University. Brazzaville, Republic of Congo, Hospital and University Center. Brazzaville, Republic of Congo,
[6]Faculty of Sciences and Techniques Mohammedia Hassan II University of Casablanca, Morocco
[7]Centre Medical Cite des Aveugles, Mont Ngafula, DR Congo

Corresponding Author: Aliocha Nkodila Natuhoyila

ABSTRACT

Background: Blood transfusions carry higher risk of transmitting infections such as HBV. The University of Kinshasa Clinics has a crucial mandatory role for pre-transfusion screening of blood transmitted-transfusion infections.
Objective: The aim of this study was to analyze the prevalence and the trends of HBV seropositivity among blood donors
Methods: A retrospective analysis was carried out at University Kinshasa Clinics, using Blood donors records during 2003 - 2006 and 2008 – 2013. Frequencies of HBV per year, age, sex and type of blood donors (volunteer- Blood donors and familial- Blood donors) were calculated and compared for association with TTI using univariate and multivariate logistic regression analyses after adjusting for confounders to identify significant independent determinants of TTI.
Results: Out of 26'341 Blood donors, 4% (n=1,057/26,341) were seropositive for HBV.
Age<55 years (OR= 1.5; 95%CI 1.1 – 2; P+o.oo8), HIV seropositivity (OR=1.5; 95%CI 1.03 – 2.1; P=0.033), and years 2009, 2011 and 2012(OR=1.5; 95%CI 1.03 – 2.1; P=0.033) were the independent determinants of HBV seropositivity.
Conclusion: This study shows an inverted U – shaped relationship between HBV related to young adults (Peak in 2011) and over time. Urgent further research, policy, health systems, intervention of the government, university authorities, and staff of blood transfusion unit are needed to minimize the mass problem of HBV at University of Kinshasa Clinics.

Keywords: Blood donor, HBV, serology, prevalence, DRC

INTRODUCTION

The practice of blood transfusion (BT) is a crucial therapeutic alternative in the management of anaemia of various origins. Despite its virtues, BT is not safe for both the recipient and the donor. It is often associated with accidents and incidents of an immunological and non-

immunological nature, particularly infectious ones (transmission of infectious agents transmitted by transfusion: HIV, HBV, HCV, Syphilis...), metabolic and mechanical. [1] To avoid these complications, BT requires a selection of blood donors (BD) and a biological qualification of blood products and components. [1,2]

Hepatitis B viruses (HBV) are a major global population health problem. [3-5]. According to the WHO, the prevalence of blood transfusion-transmitted infections (TTIs) would vary with the economic level of the countries concerned. It was 2.47% in developed countries compared to 7.2% in developing countries for HBV. [6] In France, the prevalence of Ag HBs among new blood donors was estimated at 0.071%. [7] In the Philippines, however, this prevalence in the DS population was estimated at 4.2%. [8] In West Africa, prevalences of AgHBs were estimated at between 14.3%-15.4%. [9-12]

In Madagascar, the seroprevalence of HBV was 3.21% among voluntary blood donors. However, in Central Africa it was in the order of 6.91% - 11.05%, while it is included in the range of [3.7%-22.2%] in the DRC. [3-5, 10, 13,14]

At the University Clinics in Kinshasa (CUK), the systematic search for AgHBs in all BD began in 1989. Since then, no data compiled on the seroprevalence of these viral infectious markers is available. The extent of the gap between evidence and the management of safe blood transfusions justified the initiation of this work.

The overall objective of this study was to estimate the seroprevalence of HBV (AgHBs) in BD at the Kinshasa University Clinics during the 2003-2013 period for HBV and 2005-2013 for HCV.

To achieve the overall objective of this study, the following specific objectives have been set: to describe the distribution of DS by gender, age, medical departments of origin, year of admission, month of admission, The Type of BD Estimate Trends in HBV over the study period identify associated factors and independent determinants of HBV seroprevalence.

MATERIALS AND METHODS

- **Type, Site and period of etude**

This is a descriptive and analytical cross-sectional epidemiological study conducted at the Blood Bank of The University Clinics of Kinshasa during the period 2003-2006 and 2008-2013.

- **Study population**

The study population consisted of blood donors who donated at least one blood donation to the Blood Bank of the University Clinics of Kinshasa during the study period. Inclusion criteria Included blood donors eligible for blood donation and whose references (information) were found in the various Blood Bank registers during the study period.

Exclusion and non-inclusion criteria: were not included all donors whose donations were pre- or post-study period; Excluded were any blood donors whose interest parameters were not included in the various blood bank registers.

- **Study results**

Demographic and biological data from the included subjects were collected from the records using a pre-established information collection sheet.

- **Demographics**

Demographic data included age, gender, type of blood donor, department recommending blood donor, year and month of blood donor admission.

- **Biological data**

They included the results of hiv, HBV and HCV serology. The nature (Type) of the BD was voluntary (unpaid voluntary donor (UVD) or family (donor of restitution or compensation or replacement). [15-17] The DFs were categorized according to the Medical Departments where the family member receiving blood was hospitalized (Anesthesia-Resuscitation, Surgery, Gynecology-Obstetrics, Internal Medicine, Pediatrics, Specialties, Non-CUK and Unspecified departments).

- **Laboratory analysis**

All blood donations were detected for the identification of AgHBs and HCV antibodies. Immuno-enzymatic tests (ELISA) or rapid immuno-chromatographic tests (TDRs) were used as recommended by WHO for blood transfusion. [4,18]

- **Statistical analysis**

Data pre-coded and entered using Excel software (Microsoft Office Excel 2007) has been validated and analyzed using Biostatistical methods.

- **Validation**

Validation and evidence were ensured as follows: double input with Epi-data; file cleaning and consistency testing (placement of variables to the spreadsheet line or column) and completeness test.

- **Statistical analysis**

Information obtained from interest variables was summarized in the form of figures and scientific tables.

Uni-varied analyses

It was used to describe the general characteristics, potential associated factors of the dependent variable (HBV). Category interest variables (sex, donor type, year and month of blood donation collection) were presented in the form of frequencies (number) and proportions (%).

The continuous variable, age, was summarized on average, standard deviation, quartile, minimum and maximum). Pearson's Chi-square test was used to compare % between two groups. The Trend Khi-square test was used to compare the % between 3 groups. The association strength was expressed in relation to odds (Odds-ratio - OR) with its confidence interval at 95% (IC95%) hepatitis B and a potential associated factor. The Student test was used for comparing average ages between two groups and variance analysis (ANOVA) was used to compare average age between 3 groups.

Multivariate analyses

Multivariate analyses (logistical regression) were necessary to eliminate some confounding factors among potential associated factors of hepatitis B in one-variance analyses. The variables selected in the logistic regression model were considered to be the independent and significant determinants of hepatitis B. The multivariate association between the dependent variable and the determinants, were expressed in GOLD (e) and its 95% IC, coefficient, error-standard, Wald's Chi-square and reference.

- **Statistics Tests**

The probability (p) for the statistical difference was 0.20 for logistic regression. Finally, the value of p-0.05 was considered a threshold of statistical significance (degree of significance) according to the null hypothesis and the alternative hypothesis.

- **Statistical Software**

All statistical analyses were conducted using IBM SPSS (The Statistical Package for the Social Sciences) version 22 for Windows (IBM Inc, Chicago, Ilinois, USA).

RESULTS

Description of general characteristics of the study population

Age and Sex in the Study Population

A total of 26341 blood donors were registered with the UK Blood Bank during the period 2003-2013. The average age of this population was 33.3-11 years. The extremes were 18 and 65 years old. The median age was estimated at 30 years. The age groups most represented were 18-24 years (23.05% n-6071) and 25-29 years (23.23% n-6119) (Figure 1). There was a male predominance (n-21200) on the admission of female donors (n-5141): sex ratio 4 Men: 1 woman (Figure 2).

Distribution of the study population by type of blood donation

DBs were rare (n-8418) compared to the over-representation of DFs (n-17923).

Population distribution by years of admission

The peak of DS was observed in 2009-2010 against the nadir hole (lowest frequency) observed in 2008 (Figure 3).

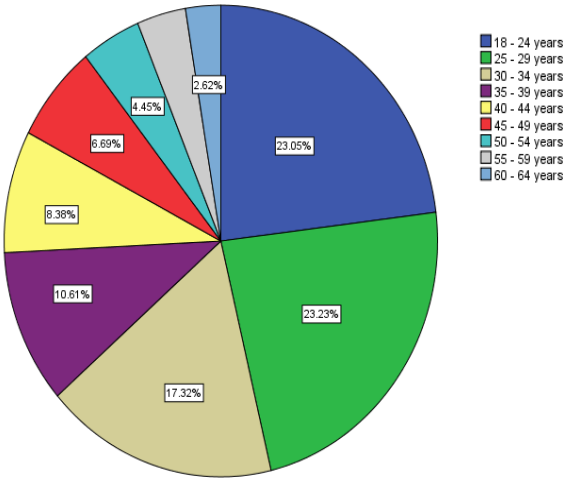

Figure 1. Distribution of the study population according to age group.

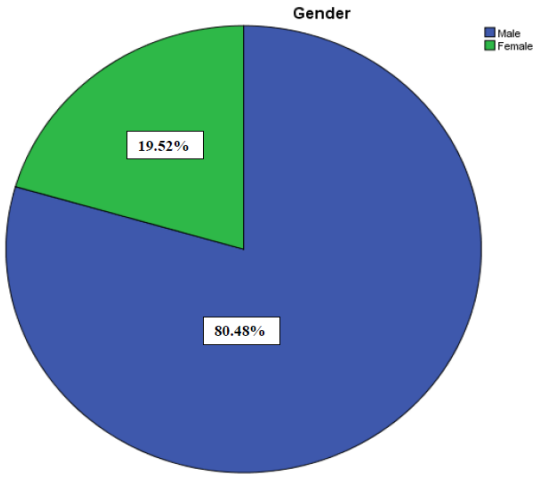

Figure 2. Distribution of the study population by sex

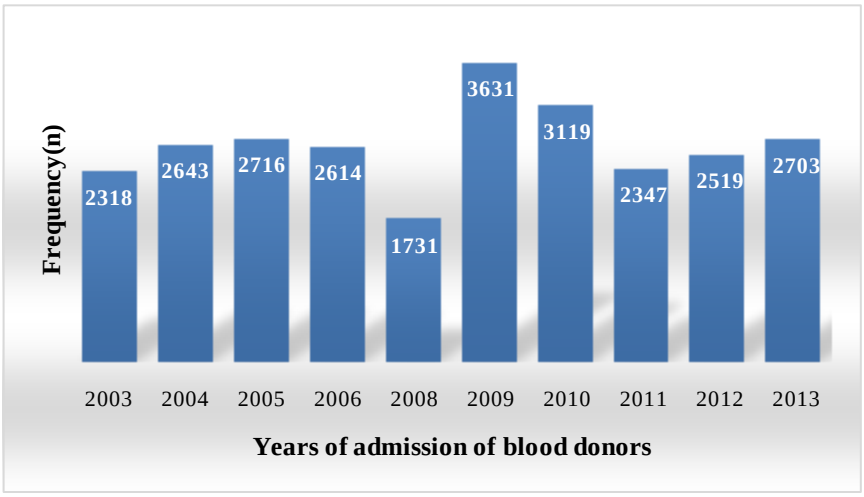

Figure 3. Distribution of the study population by years of the collected blood

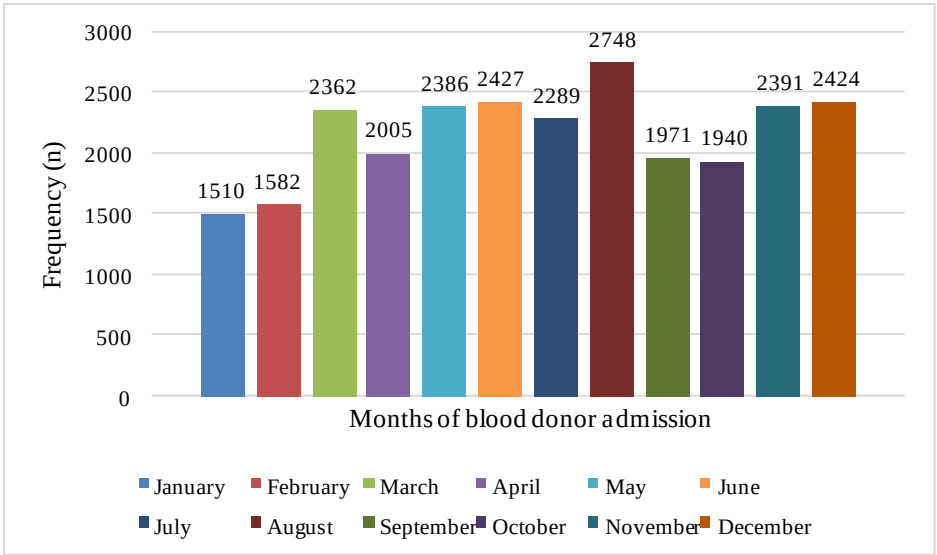

Figure 4. Distribution of the study population by month of the collected blood

.

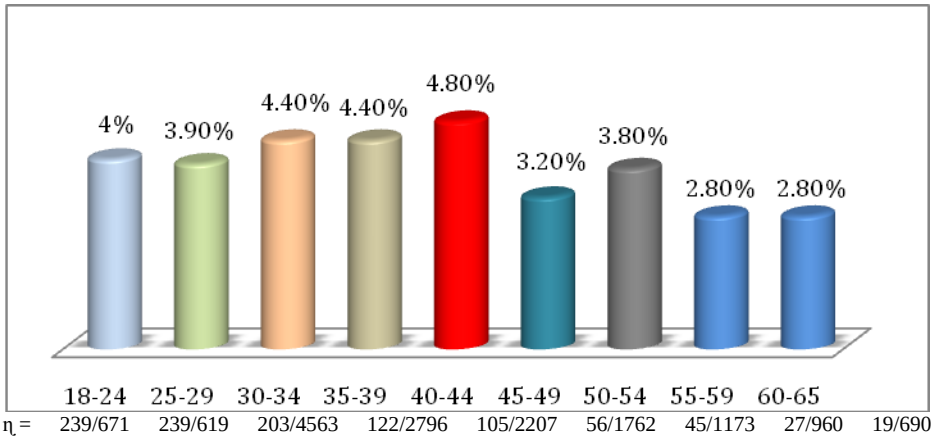

Figure 5. Distribution of the seroprevalence of hepatitis B according the age group

Table 1. Distribution of the average age and seroprevalence of hepatitis B by year and month of de blood collection

YEARS				MONTHS		
	AgeS (Years)	Seroprevalence		Seroprevalence		
Years	Mean ± Se	Frequencies(n)	%	Month	Frequencies(n)	%
2003	31.2 ± 11.1	55/2318	2.4	January	80/1510	5.3
2004	32.2 ± 11.3	78/2643	3.0	February	82/1582	5.2
2005	33.8 ± 11.0	124/2716	4.6	March	97/2362	4.1
2006	34.0 ± 11.0	138/2614	5.3	April	69/2005	3.4
2008	33.7 ± 10.1	14/1731	0.8	May	101/2386	4.2
2009	33.4 ± 10.5	181/3631	5.0	June	120/2427	4 .9
2010	33.8 ± 10.9	122/3119	3.9	July	110/2289	4.8
2011	32.7 ± 10.4	133/2347	5.7	August	91/2748	3.3
2012	33.5 ± 10.7	70/2519	2.8	September	53/1971	2.7
2013	34.0 ± 12.2	142/2703	5.3	October	60/1940	3.1
				November	121/2391	5.1
				December	73/2424	3.0
AOV, P	<0.0001	Pearson Chi-square, P	<0.0001			<0.0001

Table 2. Factors associated with prevalence of hepatitis B

VARIABLES	HBV SEROPREVALENCE		
	% (n)	OR (95%CI)	P
AGE			
18-54 years	4.1 (1011/24691)	1.5 (1.1-2)	0.009
55-65 years	2.8 (46.00/1650)		
HIV (anti-VIH 1-2 Ac status)			
Positive	5.6 (32.00/776.0)	1.4 (1-2.04)	0.036
Negative	4 (1025/25765.0)		
Hepatitis C (anti-HCV Ac status)			
Positive	6.2 (16.00/260.0)	1.6 (1-2.6)	0.061
Negative	4.0 (1041/26081)		
Seosonal adjustment			
Smal dry season + smal rainy season + part of dry season : January-july and november	4.6 (780.0/16952)	1.6 (1.4-1.8)	<0.0001
Long dry season + a large rainy season: August-october-december	3.0 (277.0/9389)		
Years (Enso)			
Cold years (Lanina) 2006. 2008. 2009.2011 and 2012	4.2 (782.0/18662)	1.2 (1.024-1.4)	0.022
Normal year 2003, 2004 et 2013	3.6 (275.0/7679)		

Population breakdown by months of blood collection

The highest frequency of admission of blood donors occurred in August compared to the lowest observed in January-February (Figure 4). DBs were more recruited during the dry season against dF received much more during the rainy season, the difference was statistically significant (p.0001).

Influence of sex and age in the study population

Male donors were (p-0,0001) more common in the age group - 25 years (82.7% n-5018/6071) than women (17.3% n-1053/6071). Men were more frequent (p-

0.0001) among DBs (84% n - 7070/8418) than women (16% no. 1348/8418). Among DFs, on the other hand, the frequency of female DS was estimated at 21.2% n-3793/17923). DFs were more common (p-0.0001) among men (66.65% n - 14130/21200) than DBs (33.35% no. 7070/21200). This prevalence of DF was also observed in women where their frequency was estimated at 73.78% n-3793/5141) and that of DB at (26.22% n-1348/5141).

Indeed, the sex ratio was 5 men: 1 woman in young group donors under 25 years of age versus a sex ratio of 4 men: 1 woman in donors of upper age 25 years. The sex ratio was 5 men: 1 woman in DB versus 4 men: 1 woman in DF.

There was a very significant and positive relationship between the evolution of the admission years and the increase in the age of donors: a plateau of the age curve is between 2005 and 2013 against the increase in age between 2003 and 2004 (Table 1). There were at least two average dS age values that were significantly different depending on the years of admission. DBs were significantly younger (age 31.9-10.9 years; p-0,0001) than DFs (age 33.9-11 years).

Table 3. Determinants independents with prevalence of hepatitis in population of study

VARIABLES	Coefficient β	aOR (95%CI)	P-value
Age (years)			
18-54 years	0.407	1.5 (1.1-2.0)	0.008
55-65 years	Reference	1	
HIV (anti-VIH 1-2 Ac status)			
Positive	0.395	1.5 (1.03-2.1)	<0.033
Negative	Reference	1	
Hepatitis C (anti-HCV Ac status)			
Positive	0.476	1.6 (1.4-1.9)	<0.0001
Negative	Reference	1	
Seosonal adjustment			
Smal dry season + smal rainy season + part of dry season : January-july and november	0.178	1.5 (1.03-2.1)	0.0033
Long dry season + a large rainy season: August-october-december	Reference	1	
Constant	-4 .028		< 0.0001

Magnitude of HEPATITE Virus B

Of the 26341 blood donors received during the 1057 study period were positive for AgHBs, a seroprevalence of HBV of 4%.

Distribution of HBV seroprevalence by year, month of blood collection and age groups

The seroprevalence of HBV varied significantly (p-0,0001) depending on the year and month of DS selection (Table 1). There was a significant link between years of DS recruitment and HBV seroprevalence (Table 1)

The mode peak occurred in the 40-44 age group versus a nadir observed in the age group of at least 55 years, the difference being statistically significant (p-0.039). There is a significant link between age groups and HBV seroprevalence (Figure 5).

HBV-independent dependent variables and determinants

There was a significant association between HBV-positive and the 18-54 age group (OR-1.5 IC95% 1.1-2; p-0.009); HIV-positive (OR-1.4 IC95% 1-2.04; p-0.036); HCV-positive status (OR-1.6 IC95% 1-2.6; p-0.061) and the year of blood collection (OR-1.2 IC95% 1,024-1.4; p-0.022). The excess risk was 50, respectively; 40 ; 60 and 20% for the 18-54 age group; HIV-positive status HCV-positive status and the year of blood collection (Tables 2).After adjusting for hepatitis C, age 18 to 54, 2006, 2008, 2009, 2011 and 2012 and HIV status were significant determinants of HBV frequency (Table 3)

DISCUSSION

This study estimated the seroprevalence of HBV among blood donors at the Kinshasa University Clinics during the period 2003-2013. The prevalence of periods between 2003-2006 and 2008-2013 and the trend of HBV

infection (evolution of instant prevalence) by year of blood donation collection in these clinics were estimated. Factors influencing the extent of HBV seroprevalence were identified in univariate analysis (potential associated factors with or without confounding effects) and multivariate analysis (independent determinants using logistic regression). The interpretation of these associations has been documented according to literature, validity, factual approach and personalized assumptions.

The blood donors in this study were defined by a population of developing countries (predominantly young age pyramid) including the DRC: sex ratio: 1 man: 1 woman and young age around 30 years. On the other hand, the general populations of economically developed and emerging countries adopt respectively an overturned age pyramid (predominant 3rd age population) and hourglass (epidemiological and demographic transition).

A total of 26341 blood donors were registered during the presented study, of which 32% were volunteers and 68% were family or donor. Several other studies have observed a predominance of family donors. [12, 14,17] The years 2009 (Lanina year: climate variety in the context of climate change for the paroxysmal cold) and the month of August (large dry season) followed by the months November-December (great rainy season) were the time of the strong vulnerabilities of injured blood recipients from road traffic and malaria. [21]

HBV SEROPREVALENCE

Magnitude and evolution of HBV seroprevalence

The seroprevalence rate of AgHBs in this study was estimated at 4%, similar to those in the Philippines and eastern DRC, [8,16] lower than those in Burkina Faso, Niger, Cameroon and western DRC [9,10, 12-15] and higher than those observed in France Algeria, Madagascar and eastern DRC. [6, 7, 16,19,20]

Variations in this seroprevalence are reported to be related to modes of hepatitis transmission and cultural traditions (homosexuality, bisexuality, substance abuse, tattooing, promiscuity, sexual multi-partnerships and vaccination (use in the common syringes and needles). This situation could also be explained by the very high number of circumstantial DSs which, unlike regular donors, do not benefit from behavioural education in terms of ITT prevention and regular counselling within the space of all Quarters.

The seroprevalence of HBV showed a neutral trend in this study, although it had a tendency to decrease over the years in Madagascar and France. In Algeria, however, this prevalence remained stable for 2002-2006 and 2006-2009. [6, 7.20]

HBV DISTRIBUTION FACTORS

Factors with indifferent effects on HBV

Sex showed no significant association with AgHBs in this study. In Niger, male sex is a factor associated with hepatitis B. [10] The usual heterosexuality in Sub-Saharan Africa may explain the neutral effect on HBV. On the other hand, bisexuality and homosexuality would explain the male predominance in these ITTs observed in developed countries. [7]

Factors influencing the seroprevalence of HBV

The seroprevalence distribution of AgHBs was influenced by the years and seasons of blood donation collection, the year 2006,2011 and 2013, the month of January-February and November, the age between 18-54 years, HIV-positive, HCV-positive, seasonalization, normal and cold years (Lanina year) in a univariate analysis of this study. On the other hand, in multivariate analysis, the significant independent determinants of the double risk of AgHBs (HBV) were age 54, HIV-positive, seasonalization and cold years. Those results corroborated those found in Bukavu in the DRC where for AgHBs serology, seroprevalences differed significantly depending on the year. [16]

Recent studies report an association between climate change and infectious diseases. The interaction of age and environmental factors would instead expose young age to hepatitis B. [22]

CONCLUSION AND PERSPECTIVES

This study confirms that the hepatitis B virus is a major public health problem and shows that the AgHBs trend is unstable during the study period. Important determinants of HBV infection were blood donor age, HIV status, seasonalization and cold years. This study also showed that family donors did not present more risk to blood donation than unpaid voluntary donors or DBs. In addition, this study showed a marked increase in family-type blood donations as opposed to voluntary and unpaid blood donation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

We would like to thank all those who, from far and near, were willing to participate in this study: all the investigators, the donor blood who consented to carry out the hepatitis B tests.

REFERENCES

1. Choudhury N. Transfusion transmitted infections: How many more? Asian J Transfus 2010; 4(2): 71–2.
2. Toungouz M, Mathys E, Thomas I, Deneys V, Hübner R et al. Bonnes pratiques de transfusion à l'usage des hôpitaux. Conseil Supérieur de la Santé. Belgique 2010 ; (8381) ,1-80
3. OMS. Unité de la Sécurité transfusionnelle. Organisation mondiale de la Santé 1999
4. OMS. Dépistage des infections transmissibles par transfusion dans les dons de sang: recommandations. ISBN 978 92 4 254788 7. Organisation Mondiale de la Santé 2010
5. OMS. Sécurité transfusionnelle et approvisionnements en sang. Aide-mémoire 2013, (279). http://www.who.int/mediacentre/factsheets/fs279/fr/
6. Rakotoniaina A, Randriamanantany Z, Ranaivosoa K, Andriambelo V, Fortuné H, RakotoAlson O, Rasamindrakotroka A. Séroprévalence du VIH, VHB, VHC et de Treponema pallidum chez les donneurs du sang bénévoles au Centre National de Transfusion Sanguine d'Antananarivo de 1992 à 2010. Rev. méd. Madag. 2013 ; 3(2): 264-268
7. Pillonel J, laperche S, Courbil R. Surveillance épidémiologique des donneurs de sang en France 1992-2012.InVS 2013
8. Yanase Y, Ohida T, Kaneita Y, Agdamag DMD, Leaño PSA, Gill CJ. The prevalence of HIV, HBV and HCV among Filipino blood donors and overseas work visa applicants. Bull World Health Organ 2007 ; 85(2): 131–137
9. Nagalo MB, Sanou M, Bisseye C, Kaboré MI, Nebie YK, Kienou K et al. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis among blood donors in Koudougou (Burkina Faso) in 2009. Blood Transfus 2011 ;9(4):419-24
10. Mayaki Z, Dardenne N, Kabo R, Moutschen M, Sondag D, Albert A, Gérard C. Séroprévalence des marqueurs de l'infection chez les donneurs de sang à Niamey (Niger). Elsevier Masson 2013
11. Loua A., Magassouba FB, Camara M., Haba NG, Balde AM. Bilan de 4 ans de sérologie VIH au centre national de transfusion sanguine de Conakry. Bull Soc PatholExot 2004 ; 97(2) : 139-141
12. Mogtomo MLK, Fomekong SL, Kuate HF, Ngane AN. Détection des agents infectieux dans Les Banques de sang de Douala (1995-2004). Cahiers d'études et de recherches francophones / Santé. 2009 ; 19(1) :1-6
13. Muwonga J, Mulumba JA, Vercruysse V, Kayembe N, Gerad C, Bwassa JP, Sonda GD, et Margraff V (2000). Séroprévalence du virus de l'hépatite C chez les donneurs de sang à Kinshasa. Vox sanguinis, 402.
14. Mbendi NC, Longo MB, Mbendi NS,Muyembe TJJ, Situakibanza NH. Prévalence du VIH et de l'antigène HBs chez les donneurs du sang. Risque résiduel de contamination chez les receveurs de sang à Kinshasa-Est, République Démocratique du Congo. Rev. Med. Brux2007; 28 (3): 145-49.
15. CNTS.Prévalence du VIH, du VHB et du VHC chez les donneurs de sang au centre national de transfusion de Kinshasa. 2006http://www.aaffchge.org/jgaf/14emes-

jgaf/programme-hepatologie-et-gastro-enterologie/43-session-iv-hepatologie-2/51-prevalence-du-vih-du-vhb-et-du-vhc-chez-les-donneurs-de-sang-au-centre-national-de-transfusion-de-kinshasa

16. Namululi BA., Guerrieri C, Dramaix M. Impact du mode de recrutement des donneurs de sang sur la prévalence du VIH et du VHB à Bukavu, République démocratique du Congo. Med Sante Trop 2012 ; 22(1) : 69-74
17. Guindo O. Infections à VIH et à VHB chez les donneurs de sang. Thèse pharmacie Bamako 2003 ; 4-19
18. Nagalo BM. Sécurité transfusionnelle au Burkina Faso: Séroprévalence et incidence des virus de l'immunodéficience humaine(VIH), des hépatites B & C (VHB et VHC) et de Treponema pallidum chez les donneurs de sang. Thèse de doctorat de l'Université de Ouagadougou. Décembre 2012 ; 1-176
19. Galmiche JP, Aubrège A., Assié P, Caro D, Chavanet P, Colomb ,Ducrotté P. Hépatite C : dépistage et traitement. Agence Nationale pour le Développement de l'Évaluation Médicale. Juiilet1997
20. OMS. Dépistage des infections transmissibles par transfusion dans les dons de sang: recommandations. ISBN 978 92 4 254788 7. Organisation mondiale de la Santé 2010
21. Aïnas L, Toudeft F, et Arridj B. Prévalence des infections VIH, VHB, VHC et Syphilis chez les donneurs de sang. Revue algérienne d'Hématologie 2010 ; 2170 (0729) :13.
22. Loua A, NzeNkoure G. Relative safety of first-time volunteer and replacement donors in Guinea. Transfusion 2010;50:1850-1.

How to cite this article: Sumbu BMM, Longo-Mbenza B, Natuhoyila AN et.al. Seroprevalence and determinants of hepatitis B among blood donors in the university clinics of Kinshasa (2003-2006, 2008- 2013). Int J Health Sci Res. 2020; 10(2):150-158.

******