



Original Paper

<http://ajol.info/index.php/ijbcs>

<http://indexmedicus.afro.who.int>

Prevalence of serological markers for Hepatitis B and C Viruses, human immuno-deficiency virus and *Treponema pallidum* among blood donors in Ouagadougou, Burkina Faso

Abibou SIMPORE^{1,2,4}, Alice KIBA-KOUMARE¹, Arzouma Paul YOODA^{2,4}, Abel Pegdwendé SORGHO^{2,4}, Abdou Azaque ZOURE^{2,3,4*}, Valerie Bapio BAZIE^{2,4}, Prosper BADO⁴, Florencia Wendkuuni DJIGMA^{2,4}, Salam SAWADOGO¹, Tegwinde Rebeca COMPAORE^{2,3,4}, Teega-Wendé Clarisse OUEDRAOGO^{2,4}, Cheick Ali LINGANI¹ and Jacques SIMPORE^{2,4}

¹National Blood Transfusion Center (CNTS), Ouagadougou, Burkina Faso.

²Laboratory of Molecular Biology and Genetics (LABIOGENE), Joseph KI-ZERBO, University, Ouagadougou, Burkina Faso.

³Research Institute in Health Sciences (IRSS/CNRST), Ouagadougou, Burkina Faso.

⁴PietroAnnigoni Biomolecular Research Center (CERBA), Ouagadougou, Burkina Faso.

*Corresponding author; E-mail: abdouazaque@gmail.com; Tel.: 00 226 50 34 48 01

Received: 01-09-2021

Accepted: 11-01-2022

Published: 28-02-2022

ABSTRACT

In Sub-Saharan Africa, transfusion safety remains a challenge due to the high endemicity of blood-borne infections. This study aimed to determine the seroprevalence of human immunodeficiency virus (HIV), hepatitis B (HBV), hepatitis C (HCV), and *Treponema pallidum* among blood donors in Ouagadougou. This was a retrospective study in blood donor. HIV 1/2 and HCV antibodies and HBsAg were screened and confirmed with two ELISA (Enzyme Linked ImmunoSorbent Assay). While *T. pallidum* antibodies were also screened and confirmed with two serology tests. Only samples positive for both tests were counted as positive. Prevalence rates were calculated among first-time blood donors. Of 63,779 registered blood donors, 54,113 (84.84%) were first-time donors. Overall seroprevalences of HIV, HBV, HCV and *Treponema pallidum* were 2.56%, 11.87%, 5.89% and 3.22% respectively. Seroprevalences of HIV-HBV, HBV-HCV, HBV- *T. pallidum* and HIV-HBV-HCV co-infections were 0.36; 1.21; 0.54 and 0.02 respectively. The study reports that HIV, HBV, HCV and *Treponema pallidum* seroprevalences remain high among blood donors. These results highlight a potential infectious risk to blood products recipients.

© 2022 International Formulae Group. All rights reserved.

Keywords: Seroprevalence, transfusion-transmissible infections, bloods donations.

INTRODUCTION

World Health Organization (WHO) recommends routine screening of all blood donations for major pathogens including human immunodeficiency virus (HIV), hepatitis B (HBV), hepatitis C (HCV) and *T. pallidum* due to the severity and chronicity of these transfusion-transmissible infections (TTIs) (OMS, 2010). Worldwide, about 37.7 million people are infected with HIV (UNAIDS, 2018), about 257 million and 71 million people are chronic carriers of HBV and HCV respectively (OMS, 2017). In sub-Saharan Africa, TTIs are very high among blood donors with average seroprevalences of 0.9%, 6.7%, 1.3% and 0.4% respectively for HIV, HBV, HCV and *Treponema pallidum* (Tagny et al., 2018). Additionally, the transfusion infectious risk is very high, due to the high prevalence of transmissible infections among African populations. Over the period of 2006 to 2017, the estimated residual transfusion risk was between 1/25,000 and 1/29,000 donations for HIV, 1/302 and 1/1,775 donations for HBV and between 1/313 and 1/4,808 donations for HCV (Ouattara et al., 2006; Touré-Fall et al., 2009; Lefrère et al., 2011; Yooda et al., 2019). In Burkina Faso, previous studies have reported seroprevalences between 0.5% - 3% for HIV, 8% - 15% for HBV, 1% - 9% for HCV and 2% - 6% for *Treponema pallidum* among blood donors (Yooda et al., 2018). Similarly, transfusion infectious risks have been estimated at 1/1366 for HIV, 1/408 for HBV and 1/213 donations for HCV at CRTS/O (Yooda et al., 2019). Such an epidemiological environment characterized by high TTI endemicity poses a threat to transfusion safety. Nevertheless, since 2005, Burkina Faso has decided to progressively apply the transfusion risk prevention measures recommended by WHO in order to improve transfusion safety. Thus, family donations have been progressively abandoned in favor of unpaid voluntary donors, blood donors are selected after a pre-donation interview based on a questionnaire administered by health personnel, and blood donations are tested by fourth generation ELISA tests. This study aimed at assessing seroprevalences of HIV,

HBV, HCV and *T. pallidum* in blood donors from July 2017 to May 2019. It will contribute to updating data on the seroprevalence of TTIs among blood donors in Burkina Faso.

MATERIELS AND METHODS

Type and population of study

This was a transversal retrospective analysis of blood donor data received over the period from July 2017 to May 2019 at the CRTS/O. It involved, 63,779 blood donors of both sexes (male and female) selected after a medical interview based on a standardized pre-donation interview questionnaire designed to identify HIV, HBV, HCV and *T. pallidum* risk situations and behaviors.

Data collection

The data collected included gender, age, donor profile (first-time donors, repeat donors), and HIV, HBV, HCV, and *T. pallidum* serological results. All these informations were extracted from the CRTS/O database managed using the Inlog®, medico-technical software.

For this study, any donor who had already been collected at least once at the CRTS/O was considered a "repeat donors". Otherwise, they were considered as "first-time donors".

HIV, HBV, HCV and *T. pallidum* serological tests

HIV, HBV and HCV serological tests were simultaneously performed using the ARCHITECT SR i1000 (Abbott Diagnostics, USA). Thus, the ARCHITECT HIV Ag/Ab Combo kit (Abbott, Wiesbaden Germany) was used for the simultaneous detection of p24 antigen and HIV1/2 antibodies; the ARCHITECT HBsAg Qualitative II kit (Abbott Ireland, Sligo Ireland) for HBsAg surface antigen, and the ARCHITECT HCV kit (Abbott GmbH & Co. KG, Wiesbaden Germany) for HCV antibodies. The positive screening samples were confirmed using a second ELISA test (Bio-Rad, Marnes la Coquette, France). While *T. pallidum* antibodies were tested by the Rapid plasma Reagin test (RPR) (Cypress Diagnostics, Langdorp, Belgium) and positive results were

confirmed with a *T. pallidum* hemagglutination test (TPHA) (Cypress Diagnostics, Langdorp, Belgium). Only samples positive for both tests (ARCHITECT and Bio-Rad,) were considered positive. Seroprevalences rates were calculated among first-time blood donors by dividing the total number of positives for each of the infectious agents (HIV, HBV and HCV, *T. pallidum*) by the total number of first-time donors.

Ethical considerations

The study received approval from the internal scientific review committee of the CNTS. The anonymity and confidentiality of the donors' serological results were respected. The study involved unpaid volunteer donors.

Statistical analysis

Data were analyzed using the Standard Statistical Software for the Social Sciences (SPSS) version 21. The chi-square test was used for comparisons and all values were considered statistically significant for $p \leq 0.05$.

RESULTS

Socio-demographic characteristics of blood donors

Of a total of 63, 779 registered blood donors, 44,152 (69.23%) were male and 19627

(30.77%) were female, resulting in a sex ratio (M/F) of 2.25 in favor of men ($p < 0.001$). The mean age of the study population was 26.06 ± 8.37 years (Table 1). Blood donors were predominantly young (70.98%) with an age range of 18 to 28 years. Among the blood donors, 54,113 (84.84%) were first-time donors and 9,666 (15.16%) had made at least two donations.

Seroprevalence of HIV, HBV, HCV and *T. pallidum*

Of the 54,113 first-time donors, 12,741 (23.54%) were infected with at least one of the four pathogens and 1,588 (02.93%) had co-infections. The overall seroprevalences were 2.56% for HIV; 11.87% for HBV, 5.89% for HCV and 3.22% for *T. pallidum* (Table 2). The seroprevalences of HIV-HBV, HBV-HCV, HBV- *T. pallidum* and HIV-HBV-HCV co-infections were 0.36; 1.21; 0.54 and 0.02 respectively (Table 3). Seroprevalences were significantly higher ($p < 0.001$) in blood donors in the age group 18-28 years with high prevalence of hepatitis B (8.69%), hepatitis C (4.42%), HIV (1.88%) and *T. pallidum* (2.19%) (Table 2).

Table 1: Socio-demographic characteristics of blood donors.

Parameters		Number (N)	Percentage (%)
Gender	M	44,152	69.23
	F	19,627	30.77
Age range (year)	18-28	45,273	70.99
	29-39	12,719	19.94
	40 -50	4,812	7.54
	51-60	975	1.53
Type of donors	first-time donors	54,113	84.84
	repeat donors	9,666	15.16
Total		63,779	100

Table 2: Seroprevalence of HIV, HBV, HCV and *T. pallidum*.

Parameters	Blood donors N (%)	HIV N (%)	<i>P</i> value	HBV N (%)	<i>P</i> value	HCV N (%)	<i>P</i> value	<i>T. pallidum</i> N (%)	<i>P</i> value
Gender									
M	36,916 (68.22)	958 (1.77)	< 0,001	4,864 (8.99)	< 0,001	2,307 (4.26)	< 0,001	1,201 (2.22)	< 0,001
F	17,197 (31.78)	431 (0.79)		1,558 (2.88)		880 (1.63)		542 (1.00)	
Total	54,113 (100)	1389 (2.56)		6,422 (11.87)		3187 (5.89)		1,743 (3.22)	
Age range									
18 à 28 years	38,467 (71.09)	1017 (1.88)	< 0,001	4,701 (8.69)	< 0,001	2,390 (4.42)	< 0,001	1,184 (2.19)	< 0,001
29 à 39 years	10,753 (19.87)	256 (0.47)		1,183 (2.19)		543 (1.00)		385 (0.71)	
40 à 50years	4,068 (7.52)	92 (0.17)		464 (0.86)		196 (0.36)		134 (0.25)	
51 à 60years	825 (1.52)	24 (0.04)		74 (0.13)		58 (0.11)		40 (0.07)	
Total	54,113 (100)	1,389 (2.56)		6,422 (11.87)		3,187 (5.89)		1,743 (3.22)	

Table 3: HIV, HBV, HCV and *T. pallidum* co-infections among blood donors.

Co-infections	Number (N)	Percentage (%)
HIV-HBV	196	0.36
HIV –HCV	125	0.2 3
HIV- <i>T. pallidum</i>	31	0.06
HBV-HCV	657	1.21
HCV- <i>T. pallidum</i>	174	0.32
HBV- <i>T. pallidum</i>	292	0.54
HIV-HBV-HCV	14	0.02
HBV-HCV- <i>T. pallidum</i>	99	0.18

DISCUSSION

Our study found a predominance of first-time donors (84%) versus a low rate of repeat donors (16%) at the CRTS/O and these data are similar to other studies conducted in Burkina Faso among blood donors (Nagalo et al., 2012; Simpoire et al., 2014). However, these data are not in line with WHO recommendations, which advocate regular donation (Van Hulst et al., 2010). This type of donation would be safer than that of first-time donors. It is therefore important to develop strategies to retain blood donors in order to increase the rate of regular donors in Burkina. Our work found overall seroprevalences of 2.56% for HIV, 11.87% for HBV and 5.89% for HCV among blood donors at the CRTS/O. These seroprevalences were higher than those of 0.8% for HIV (CNLS/IST 2019), 9.41% for HBV (Lingani et al., 2018) and 3.6% for HCV (Meda et al., 2018) reported in the general population of Burkina Faso. This observation reveals shortcomings in the medical selection of blood donors. Otherwise, it would have resulted in lower prevalence of HIV, HBV and HCV among blood donors compared to the general population. For example, in France the prevalence of HIV, HBV and HCV were respectively 70 times, 10 times and 30 times lower than those estimated in the general population (Pillonel et al., 2012). It is therefore important to revise the pre-donation questionnaire as well as the medical selection procedure for blood donors in Burkina Faso, in order to better identify the behaviors of blood donors at risk of transmitting infections and to exclude them from blood donation.

TTI seroprevalences were associated with the age of blood donors. Indeed, the young fringe of blood donors aged 18 to 28 years was the most affected by HIV (1.88%), HBV (8.69%), HCV (4.42%) and *T. pallidum* (2.19%). While this fringe was the most representative (70.99%) to blood donation. This constitutes a potential transfusion infectious risk. This finding corroborates those

reported by other studies in Burkina Faso (Nagalo et al., 2011a; Nagalo et al., 2012; Yooda et al., 2019) and generally in Africa (Tagny et al., 2014). Several authors report (Tao et al., 2014; Eko Mba et al., 2018) that young people are more sexually active and are not aware of the means of protection against sexually transmitted infections. In addition, they are more inclined to engage in risky behaviors such as injecting drug use, piercing and tattooing (Tao et al., 2014; Deressa et al., 2018).

HIV seroprevalence (2.56%) was similar to those of 2.21% in 2011 and 2.5% in 2018 found respectively among blood donors in Koudougou (Nagalo et al., 2011b) and Ouagadougou (Nagalo et al., 2012). It was also similar to the 2.1% (Wongjarupong et al., 2021) found among blood donors by a recent study that involved four main cities (Ouagadougou, Bobo, FadaN'Gourma and Koudougou) in Burkina Faso. A comparison of our results with those obtained in previous studies shows that HIV prevalence remains high among blood donors in Burkina Faso. This prevalence of 2.56% was also similar to the 2.16% (Jary et al., 2019) found among blood donors in a neighboring country (Mali). It was lower than the 3.3% reported among blood donors in Cameroon (Ankouane et al., 2016).

HBV seroprevalence (11.87%) was almost twice as high as HCV (5.89%), four times higher than HIV (2.56%) and three times higher than *T. pallidum* (3.22%). This predominance of HBV (11.87%) in blood donors reflects the epidemiology of HBV in the general population of Burkina Faso, which is estimated at 9.41% (Lingani et al., 2018). This prevalence in the general population is similar in other neighboring countries; 11.01% in Benin (Lozez et al., 2016) and 6.94% in Nigeria (Abdulazeez et al., 2014).

This prevalence corroborates the data in the literature that classify Burkina Faso in an area of high HBV endemicity ($\geq 8\%$) (OMS,

2017). This seroprevalence (11.87%) is decreasing compared to those of 13.4% (Nagalo et al., 2012), 14.96% (Nagalo et al., 2011b) and 13.4% (Wongjarupong et al., 2021) obtained among blood donors in Burkina Faso. This decrease could be explained by the impact of awareness campaigns organized in recent years on the modes of transmission of these viruses as well as on prevention measures such as vaccination against HBV. The seroprevalence found in our study was similar to those reported in Cameroon (12.6%) (Ankouane et al., 2016) but higher than those reported in Gabon (7.28%) (Eko Mba et al., 2018), Kenya (3.46%) (Onyango et al., 2018) and Sierra Leone (9.7%) (Yambasu et al., 2018). These differences in seroprevalences observed are attributable to the geographical distribution of HBV by region.

The HCV seroprevalence (5.89%) obtained in the study confirms the WHO data that classify Burkina Faso in a high HCV endemicity area ($\geq 3.5\%$) (Meda et al., 2018). This seroprevalence is similar to that of 6.3% (Nagalo et al., 2012) among blood donors in Ouagadougou; however, it is higher than the 4.4% Yooda et al., 2019 found among blood donors in the same city. This observation shows that seroprevalence (5.89%) remains high among blood donors. This could be explained by the lack of vaccination against this virus. Compared to other African countries, HCV seroprevalence (5.89%) is higher than those reported among blood donors in Cameroon (3.2%) (Ankouane et al., 2016), Kenya (3.21%) (Onyango et al., 2018) and Sierra Leone (1%) (Yambasu et al., 2018).

The *T. pallidum* seroprevalence of 3.22% obtained in the present study was similar to the 3.96% (Nagalo et al., 2012) and 2.9% (Simpore et al., 2014) reported among blood donors in Burkina Faso and 3.2% in Gabon (Eko Mba et al., 2017). It was higher than 1.7% (Ouédraogo et al., 2012) and 1.5% (Bisseye et al., 2013) obtained in blood donors in Burkina Faso. It was also higher than those

found in Gabon (Bisseye et al., 2019) and Kenya (Onyango et al., 2018) of 2.4% and 1.56% but less than 4.9% in Tchad (Dongous et al., 2020). These differences in seroprevalence could be explained by the geographical distribution of the disease and the sensitivity of the tests used (ELISA or rapid tests).

In addition, the study reported several types of co-infections among blood donors. These include HIV-HBV, HBV-HCV, HBV-*T. pallidum* and HIV-HBV-HCV co-infections were respectively 0.36; 1.21; 0.54 and 0.02. These co-infections are frequently encountered because the three viruses share common transmission routes (Kabinda Katchunga 2010).

Conclusion

The study shows that the prevalence of TTIs remains high among blood donors at the CRTS/O. This constitutes a threat to blood safety. It is therefore necessary to develop additional strategies for the prevention of infectious transfusion risks such as the retention of blood donors, the improvement of the efficiency of medical selection of donors, the promotion of HBV vaccination, the implementation of PCR (polymerase chain reaction) tests and constant epidemiological surveillance of these TTIs.

ACKNOWLEDGEMENTS

We thank the blood donors for their fidelity to the regional blood transfusion center of Ouagadougou.

AUTHORS' CONTRIBUTIONS

AS and JS have substantial contributions to conception and design, acquisition of data, analysis and interpretation of data; AS, KTCAR, APY, AAZ carried out drafting the article or revising it critically for important intellectual content; and VB, PB, SS, RTC, CT-WO, have final approval of the version to be published. LCA carried out the collection of

data. SJ have acquisition of funding, and general supervision of the research group. All authors have read and corrected the manuscript.

COMPETING INTERESTS

The authors declare no conflict of interest.

REFERENCES

- Abdulazeez AA, Nimat A, Shola K. 2014. Carriage rates of hepatitis B virus among individuals of different blood group systems and haemoglobin genotype. *Int. J. Biol. Chem. Sci.*, **8**(1): 211-217. DOI: <http://dx.doi.org/10.4314/ijbcs.v8i1.19>
- Ankouane F, Noah Noah D, Atangana MM, Kamgaing Simo R, Guekam PR, Biwolé Sida M. 2016. Seroprevalence of hepatitis B and C viruses, HIV-1/2 and syphilis among blood donors in the Yaoundé Central Hospital in the centre region of Cameroon. *Transfusion Clinique et Biologique : Journal de la Societe Francaise de Transfusion Sanguine*, **23**(2): 72-77. DOI: 10.1016/j.tracli.2015.11.008
- Bisseye C, Mba J-ME, Ndong JMN, Kosiorek HE, Butterfield RJ, Mombo LE, M'batchi B, Borad MJ, Nagalo BM, Allain J-P. 2019. Decline in the seroprevalence of syphilis markers among first-time blood donors in Libreville (Gabon) between 2004 and 2016. *BMC Public Health*, **19**(1): 1-6. DOI: 10.1186/s12889-019-6489-7
- Bisseye C, Sanou M, Nagalo BM, Kiba A, Compaoré TR, Tao I, Simpoire J. 2013. Epidemiology of syphilis in regional blood transfusion centres in Burkina Faso, West Africa. *The Pan African Medical Journal*, **16**: 69. DOI: <http://dx.doi.org/10.11604/pamj.2013.16.69.2767>
- CNLS/IST (Conseil National de Lutte Contre le SIDA et les IST). 2019. Rapport d'activité sur la riposte au SIDA au Burkina Faso. Ministère de la santé, Burkina Faso.
- Deressa T, Birhan W, Enawgaw B, Abebe M, Baynes HW, Desta M, Terefe B, Melku M. 2018. Proportion and predictors of transfusion-transmissible infections among blood donors in North Shewa Zone, Central North Ethiopia. *PLoS ONE*, **13**(3): e0194083. DOI: <http://dx.doi.org/10.1371/journal.pone.0194083>
- Doungous DM, Doutoum AA, Chatté A, Dounbe RL, Gabdibe EG, Saleh O, Njintang NY. 2020. Prévalence de la syphilis chez les donneurs de sang à la Banque du Sang d'Abéché au Tchad. *Int. J. Biol. Chem. Sci.*, **14**(3): 1085-1092. DOI: 10.4314/ijbcs.v14i3.34
- Eko Mba JM, Bisseye C, Ntsame Ndong JM, Mombo LE, Bengone C, Mouelet Migolet G, M'batchi B, Kosiorek HE, Butterfield RJ, Roberts LR, Borad MJ, Nagalo BM. 2018. Prevalent hepatitis B surface antigen among first-time blood donors in Gabon. *PLoS ONE*, **13**(4): e0194285. DOI: 10.1371/journal.pone.0194285
- Eko Mba JM, Ntsame Ndong JM, Bisseye C. 2017. Caractéristiques socio-démographiques associées au risque de transmission du VIH, du VHC et de *Treponema pallidum* par les donneurs de sang de premier don de Libreville (Gabon): dynamique trisannuelle des infections de 2009 à 2015. *Int. J. Biol. Chem. Sci.*, **11**(1): 350-359. DOI: <http://dx.doi.org/10.4314/ijbcs.v11i1.27>
- Jary A, Dienta S, Leducq V, Le Hingrat Q, Cisse M, Diarra AB, Fofana DB, Ba A, Baby M, Achenbach CJ. 2019. Seroprevalence and risk factors for HIV, HCV, HBV and syphilis among blood donors in Mali. *BMC Infect. Dis.*, **19**(1): 1-8. DOI: 10.1186/s12879-019-4699-3
- Kabinda JM, Katchunga P. 2010. Les hépatites virales B et C chez les porteurs du virus

- de l'immunodéficience humaine à Bukavu (Sud-Kivu), République démocratique du Congo. *Journal Africain d'Hépatogastroentérologie*, **4**: 230-235. DOI: <http://dx.doi.org/10.1007/s12157-010-0204-8>
- Lefrère JJ, Dahourou H, Dokekias AE, Kouao MD, Diarra A, Diop S, Tapko JB, Murphy EL, Laperche S, Pillonel J. 2011. Estimate of the residual risk of transfusion-transmitted human immunodeficiency virus infection in sub-Saharan Africa: a multinational collaborative study. *Transfusion*, **51**(3): 486-492. DOI: [10.1111/j.1537-2995.2010.02886.x](https://doi.org/10.1111/j.1537-2995.2010.02886.x)
- Lingani M, Akita T, Ouoba S, Sanou AM, Sugiyama A, Tarnagda Z, Ohisa M, Tinto H, Mishiro S, Tanaka J. 2018. High prevalence of hepatitis B infections in Burkina Faso (1996-2017): a systematic review with meta-analysis of epidemiological studies. *BMC Public Health*, **18**(1): 551. DOI: [10.1186/s12889-018-5432-7](https://doi.org/10.1186/s12889-018-5432-7)
- Lozes E, Dougnon V, Bankole H, Hounbégnon P, Anato P, Gahou A, De Souza M, Baba-Moussa L. 2016. Prévalence de l'antigène HBs à l'Hôpital de Zone d'Abomey-Calavi/Sô-Ava au Bénin de 2009 à 2014. *Int. J. Biol. Chem. Sci.*, **10**(4): 1832-1839. DOI: <http://dx.doi.org/10.4314/ijbcs.v10i4.31>
- Meda N, Tuailon E, Kania D, Tiendrebeogo A, Pisoni A, Zida S, Bolloré K, Medah I, Laureillard D, Moles JP, Nagot N, Nebie KY, Van de Perre P, Dujols P. 2018. Hepatitis B and C virus seroprevalence, Burkina Faso: a cross-sectional study. *Bulletin of the World Health Organization*, **96**(11): 750-759. DOI: <http://dx.doi.org/10.2471/blt.18.208603>
- Nagalo B, Bisseye C, Sanou M, Nébié Y, Kiba A, Kienou K, Zongo J, Simporé J. 2011a. Molecular diagnosis of acquired human immunodeficiency virus (HIV) in pooled plasma from blood donors at the Regional Blood Transfusion Center in Ouagadougou, Burkina Faso. *Médecine Tropicale : Revue du Corps de Santé Colonial*, **71**:137-141.
- Nagalo BM, Bisseye C, Sanou M, Kienou K, Nebié YK, Kiba A, Dahourou H, Ouattara S, Nikiema JB, Moret R, Zongo JD, Simporé J. 2012. Seroprevalence and incidence of transfusion-transmitted infectious diseases among blood donors from regional blood transfusion centres in Burkina Faso, West Africa. *Tropical Medicine & International Health*, **17**(2): 247-253. DOI: [10.1111/j.1365-3156.2011.02902.x](https://doi.org/10.1111/j.1365-3156.2011.02902.x)
- Nagalo MB, Sanou M, Bisseye C, Kaboré MI, Nebie YK, Kienou K, Kiba A, Dahourou H, Ouattara S, Zongo JD, Simporé J. 2011b. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis among blood donors in Koudougou (Burkina Faso) in 2009. *Blood Transfusion*, **9**(4): 419-424. DOI: [10.2450/2011.0112-10](https://doi.org/10.2450/2011.0112-10)
- OMS. 2010. Dépistage des infections transmissibles par transfusion dans les dons de sang: recommandations. OMS, Geneva.
- OMS. 2017. Global hepatitis report. OMS, Geneva. <https://www.who.int/hepatitis/.../global-hepatitis-report2017/en/>
- Onyango CG, Ogonda L, Guyah B, Okoth P, Shiluli C, Humwa F, Opollo V. 2018. Seroprevalence and determinants of transfusion transmissible infections among voluntary blood donors in Homabay, Kisumu and Siaya counties in western Kenya. *BMC Research Notes*, **11**(1): 171. DOI: [10.1186/s13104-018-3276-y](https://doi.org/10.1186/s13104-018-3276-y)
- Ouattara H, Siransy-Bogui L, Fretz C, Diane KM, Konate S, Koidio A, Minga KA, Hyda J, Koffi-Abe N, Offoumou AM, Abissey S. 2006. Residual risk of HIV, HVB and HCV transmission by blood

- transfusion between 2002 and 2004 at the Abidjan National Blood Transfusion Center. *Transfusion Clinique et Biologique : Journal de la Societe Francaise de Transfusion Sanguine*, **13**(4): 242-245. DOI: 10.1016/j.tracli.2006.03.015
- Ouédraogo A-S, Yaméogo J, Poda GEA, Kientega Y, Ouédraogo R. 2012. Prevalence of anti-CMV antibodies in blood donors in Ouagadougou (Burkina Faso). *Médecine et Santé Tropicales*, **22**: 107-109. DOI: 10.1684/mst.2012.0039
- Pillonel J, Legrand D, Sommen C, Laperche S. 2012. Surveillance épidémiologique des donneurs de sang et risque résiduel de transmission du VIH, de l'HTLV, du VHC et du VHB par transfusion en France entre 2008 et 2010. *Bulletin Epidémiologique Hebdomadaire*, **39-40**: 438-442.
- Simpore A, Bisseye C, Nagalo BM, Sanou M, Nébié Y, Ghoma-Linguissi LS, Dahourou H, Sawadogo B, Djigma F, Ouattara S, Pietra V, Nichol J, Simpore J. 2014. Importance of extending the use of polymerase chain reaction in the diagnosis of venereal syphilis in a blood transfusion center in Burkina Faso, West Africa. *The Pan African Medical Journal*, **18**(56). DOI: 10.11604/pamj.2014.18.56.3850
- Tagny CT, Laperche S, Murphy EL, Research FANfTM, Ahlonsou F, Anani L, Atinkpinda G, Lafia E, Totongnon R, Coulibaly S. 2018. Updated characteristics of blood services, donors and blood products in 11 French-speaking African countries. *Vox Sanguinis*, **113**(7): 647-656.
- Tagny CT, Murphy EL, Lefrère JJ. 2014. [The francophone Africa blood transfusion research network: a five-year report]. *Transfusion Clinique et Biologique : Journal de la Societe Francaise de Transfusion Sanguine*, **21**(1): 37-42. DOI: 10.1016/j.tracli.2013.10.002
- Tao I, Compaoré TR, Diarra B, Djigma F, Zohoncon TM, Assih M, Ouermi D, Pietra V, Karou SD, Simpore J. 2014. Seroepidemiology of hepatitis B and C viruses in the general population of burkina faso. *Hepat. Res. Treat.*, **2014**: 781843. DOI: 10.1155/2014/781843
- Touré-Fall AO, Dièye TN, Sall A, Diop M, Seck M, Diop S, Thiam D, Diakhaté L. 2009. Residual risk of transmission of HIV and HBV, in Senegalese national blood bank from 2003 to 2005. *Transfusion Clinique et Biologique : Journal de la Societe Francaise de Transfusion Sanguine*, **16**(5-6): 439-443. DOI: 10.1016/j.tracli.2009.09.005
- UNAIDS. 2018. Global HIV & AIDS statistics 2018 fact sheet. UNAIDS, USA. www.unaids.org/en/resources/fact-sheetwww.unaids.org/en/resources/fact-sheet
- Van Hulst M, Smit Sibinga CT, Postma MJ. 2010. Health economics of blood transfusion safety--focus on sub-Saharan Africa. *Journal of the International Association of Biological Standardization*, **38**(1): 53-58. DOI: <http://dx.doi.org/10.1016/j.biologicals.2009.10.006>
- Wongjarupong N, Oli S, Sanou M, Djigma F, Kiba Koumare A, Yonli AT, Hassan MA, Mara K, Harmsen WS, Therneau T, Barro O, Vodounhessi G, Sawadogo S, Chamcheu JC, Simpore J, Roberts LR, Nagalo BM. 2021. Distribution and Incidence of Blood-Borne Infection among Blood Donors from Regional Transfusion Centers in Burkina Faso: A Comprehensive Study. *Am. J. Trop. Med. Hyg.*, **104**(4): 1577-1581. DOI: <http://dx.doi.org/10.4269/ajtmh.20-0601>
- Yambasu EE, Reid A, Owiti P, Manzi M, Murray MJS, Edwin AK. 2018. Hidden dangers-prevalence of blood borne

- pathogens, hepatitis B, C, HIV and syphilis, among blood donors in Sierra Leone in 2016: opportunities for improvement: a retrospective, cross-sectional study. *The Pan African Medical Journal*, **30**: 44-44. DOI: <http://dx.doi.org/10.11604/pamj.2018.30.44.14663>
- Yooda AP, Sawadogo S, Soubeiga ST, Obiri-Yeboah D, Nebie K, Ouattara AK, Diarra B, Simpoire A, Yonli YD, Sawadogo A-G, Drabo BE, Zalla S, Siritié AP, Nana RS, Dahourou H, Simpoire J. 2019. Residual risk of HIV, HCV, and HBV transmission by blood transfusion between 2015 and 2017 at the Regional Blood Transfusion Center of Ouagadougou, Burkina Faso. *Journal of Blood Medicine*, **10**: 53-58.
- Yooda AP, Soubeiga ST, Nebie KY, Diarra B, Sawadogo S, Ouattara AK, Obiri-Yeboah D, Yonli AT, Tao I, Sorgho PA, Dahourou H, Simpoire J. 2018. Impact of Multiplex PCR in Reducing the Risk of Residual Transfusion-Transmitted Human Immunodeficiency and Hepatitis B and C Viruses in Burkina Faso. *Mediterr. J. Hematol. Infect. Dis.*, **10**(1): e2018041. DOI: 10.4084/mjhid.2018.041