International Journal of Medical Science and Clinical Research Studies

ISSN(print): 2767-8326, ISSN(online): 2767-8342

Volume 03 Issue 08 August 2023

Page No: 1486-1494

DOI: https://doi.org/10.47191/ijmscrs/v3-i8-02, Impact Factor: 6.597

Seroprevalence of HIV, Hepatitis B and C Viruses, and *Treponema Pallidum* among Blood Donors Attending the Garoua Regional Hospital Blood Bank, North Cameroon, a Cross-Sectional Study

Bonaventure Babinne Graobe[1,2], Bouba Gake[3], Adamou Dodo Balkissou[3,4], Clement Minsia[2], Youssoufa Taoufick[4], Guiswe Gnowe[2,5], Maina Toumpim[4], Alain G. Etoundi Mballa[6], Elias N. Nukenine[7]

[1]Department of Microbiology, Faculty of Sciences, University of Yaounde 1, Yaounde, Cameroon

[2]Higher Institute of Sciences and Techniques of Health and Management of Garoua, Garoua, Cameroon

[3]Faculty of Medicine and Biomedical Sciences of Garoua, Garoua, Cameroon

[4]Regional Hospital of Garoua, Blood Bank, Garoua, Cameroon

[5]Department of Medical Imaging and Radiotherapy, Faculty of Medicine and Biomedical Sciences of Yaounde, University of Yaounde 1, Yaounde, Cameroon

[6]Department of Disease Control, Epidemics, and Pandemics, Ministry of Public Health, Yaounde, Cameroon

[7]Faculty of Science, University of Ngaoundere, Ngaoundere, Cameroon

ABSTRACT

Background. Human immunodeficiency virus (HIV), hepatitis B (HBV), and hepatitis C virus (HCV) are transfusion-transmittable infections (TTI). They currently constitute a major public health problem in Cameroon, like in other developing countries. Little is known about the seroprevalence of HIV, HBV, HCV, and syphilis among blood donors in northern region Cameroun. This study aims at filling the gap on the unknown sero-prevalence of those markers in blood donors.

Methods. We conducted a cross-sectional study from June 04, to July 08, 2022 at the Garoua Regional Hospital Blood Bank (GRHBB). A total of 201donors were consecutively included and data on donor's sociodemographic characteristics were obtained by the national program's questionnaire. Serum samples from blood donors were tested using sensitive third generation Rapid diagnostic test (RDT) for presence of Hepatits B surface antigens (HBsAg), and antibodies to human immunodeficiency (HIV-1/2), Hepatits C (HCV) and *Treponema pallidum*; and quantitative enzyme-linked immunosorbent assays (ELISA) served for confirmation. Data were collected and entered into an Excel sheet and then exported to SPSS version 20.0 for analysis.

Results. A total of 201 blood donors were identified and the sex ratio (male/female) was 7/1, with a mean age of 32.12 ± 8.4 years (range: 19 to 57 years). Of all blood donors, 35/201 (17.4%) were infested by at least one of the four TTIs. Among blood donors, HIV, HBV, HCV and syphilis were 5 (2.5%); 26 (12.9%); 1 (0.5%) and 5 (2.5%), respectively. Co-infection with HIV-Syphilis was 1 (0.5%); and HBV-HCV 1 (0.5%).

Conclusions. This study has revealed the high prevalence of TTIs in blood donors who attended the Garoua Regional Hospital Blood Bank, identifying Hepatitis B as the greatest threat to blood safety in the North Region of Cameroon.

KEYWORDS: Blood donors, HIV, HBV, HCV, T. palladium, TTIs, North-Cameroon

ARTICLE DETAILS

Published On:
02 August 2023

Available on:
https://ijmscr.org/

INTRODUCTION

Several patients are saved each year by blood transfusions. Yet, in most developing countries, people still die from an insufficient supply of blood and blood products, a real medication according to World Health organization [1]–[4]. This particularly affects women in the context of pregnancy complications, children suffering from malnutrition, malaria, or severe anemia affecting the vital prognosis, victims of trauma, especially among poor and disadvantaged populations [2], [5]–[7]. Transfusions save lives and improve

health, but millions of patients do not have timely access to safe blood due to the lack of reliable donors [2]. Despite many medical advances made for the quality of blood to be transfused, infections related to blood transfusion remain a concern [2], [4], [8]–[10], and it also carries risks, in particular the transmission of blood borne infections, known as transfusion-transmittable infections (TTIs) which are major health challenges including different group of diseases [2]. The most common TTIs globally include human immunodeficiency virus (HIV), hepatitis B virus (HBV), Hepatitis C virus (HCV) and *T. palladium* [3], [11]–[13] .

In Cameroon, two factors account for the difficulties encountered in achieving optimal transfusion safety, the existence in the population of a high frequency of various infections, some of which are transmissible by blood transfusion, and the still insufficient proportion of voluntary donors who constitute the safest group [13]–[16]. Efforts are made to reduce the risk of transmission of TTIs through appropriate screening techniques [17], [18]. The World Health Organization (WHO) issued a statement of testing the blood donors before transfusion for at least HIV, HBV, HCV, and *T. palladium* [19].

In the North region, the prevalence in the general population of HBsAg, HCV, and HIV is 21.53%, 0.60%, 1.6% respectively [20]–[22]. The prevalence of syphilis in North region is reported only for pregnant women with rate of 3% [23].

Investigating the TTIs can provide data about the magnitude infected individuals in the community, which is helpful in diagnosis and therapy of such diseases, and in articulating health policies and protocols. Studies on TTIs markers are reported in others regions of Cameroon [17], [18], [24]–[33], while there is none published study on those markers at the Garoua Regional Hospital Blood Bank a part the study on zika virus [34]. Therefore, our study aimed to investigate the prevalence and distribution of serologic markers of TTIs, in particular, anti-HIV, HBV surface antigen (HBsAg), anti-HCV, and anti-*T. palladium* among blood donors attending the GRHBB to provide data for better strategies for management of blood provision to blood banks.

MATERIALS AND METHODS

Study Design, Setting and Period

A cross-sectional seroprevalence study was conducted at the GRHBB, from June 04, to July 08, 2022. The GRHBB unit provides blood transfusion services for the population of the north region (about 2.4 million inhabitants, spread over an area of 163 500 km^2).

Study Population

Two hundred and one blood donors were included among blood donors attending the blood bank, recruited between the periods of June 04, to July 08, 2022. The convenient sampling technique was used to choose blood donors. They were eligible to donate according to the national transfusion program, consented, interviewed, and gave blood for serum screening for TTIs. All blood donors who fulfilled the national and regional blood bank criteria were included. Blood donors who did not meet the inclusion criteria (<18 years, >65 years, <50 Kg weight, very tired, history of long-term medication use, and unwillingness to give oral informed consent) were excluded from the study.

Data Collection

Data on sociodemographic characteristics were collected at the time of blood collection, using a structured questionnaire from the national transfusion program [13]. The laboratory results on blood group, serological results of HIV, HBs Ag, HCV, and syphilis were collected after laboratory testing.

Laboratory Testing

Blood group for each blood donor was determined using blood group antisera: anti-A, anti-B, Anti-AB and anti-D for Rh factor (DIAGAST, France).

Each donor was tested for HBs Ag by the HEALGEN One-Step Rapid Test, anti-HCV by the Aria Rapid Test, anti-HIV1/2 by Allere Determine, and anti-*Treponema pallidum* by the HEALGEN Syphilis test cassette. Confirmation test for HIV, HBV, HCV and Syphilis was done using highly sensitive Enzyme-Linked Immunosorbent Assays (ELISA). The assays were; HIV Ab/Ag Combo (DIAsource immunoassay S.A., Belgium); HBsAg: ELISA version 4.0 (DIAsource immunoassay S.A., Belgium); HCV: anti-HCV ELISA version 4.0 (DIAsource immunoassay S.A., Belgium), and Syphilis: anti-*Treponema pallidum* antibody ELISA version 4.0 (DIAsource immunoassay S.A., Belgium). Test protocol and result interpretation were done according to the manufacturer's instructions of each test kit.

Data Management

The collected data was entered into an Excel sheet and then exported to SPSS version 20 for analysis. Summary statistics such as frequencies and percentages were computed. Fisher's exact test was used to search associations between the serology of blood-borne pathogens and age, sex, and blood groups. A p-value <0.05 was considered significant.

2.7. Ethical Consideration

The study was carried out within the routine activities of the Blood Bank, without any additional investigation, after approval of the Higher Institute of Health Sciences, Techniques and Management, and the Regional Hospital. Donors were not identified by name and the participant had the right to interrupt participation at any time.

RESULTS

Socio-demographic characteristics of study participants

The study included a total of 201 blood donors with 176 (89.6%) males and 25 (12.4%) females. Of them, 180 (89.6%) were family replacement blood donors, 19 (9.5%)

were remunerated blood donors, and only 2 (1.0%) were voluntary nonremunerated blood donors.

The donor's age ranged from 19 to 57 years with an average of 32.12 ± 8.4. The most common age group of donors was found to be 26 to 35 years (51.2%) followed by age group of 36 to 50 years (22.9%), and ≤25 (22.4%), while the least age group was >50 (3.5%). Further, 26.9% of the blood donors belonged to type A blood group, 28.4% had type B, 39.8% had type O, while 5.0% had type AB. In addition to this, 95.5% of the donors were Rhesus positive, while 4.5% were Rhesus negative. (Table 1)

Table 1. Sociodemographic characteristics of blood donors at the Garoua Regional Hospital Blood Bank (n = 201)

Variables	Category	Frequency	(%)
Age			
	≤25	45	22.4%
	26-35	103	51.2%
	36-50	46	22.9%
	>50	7	3.5%
Sex			
	Female	25	12.4%
	Male	176	87.6%
Occupation			
	housewife	14	7.0%
	student	20	10.0%
	worker	167	83.1%
Residence			
	Rural	84	41.8%
	Urban	117	58.2%
Marital statut			
	Single	87	43.3%
	Married	114	56.7%
Education level			
	Nonformal education level	8	4.0%
	Primary	51	25.4%
	Secondairy	99	49.3%
	University	43	21.4%
Blood group			
	A	54	26.9%
	AB	10	5.0%
	B	57	28.4%
	O	80	39.8%
Rherus D	Negative	9	4.5
	Positive	192	95.5
Donor type			
	FRBD	180	89.6%
	RBD	19	9.5%
	VNRBD	2	1.0%

Note: FRBD family replacement blood donors, VNRBD voluntary non-remunerated blood donors, RBD remunerated blood donors.

Seroprevalence of transfusion-transmittable infections

The proportion of samples that were tested positive for at least one TTI was 35 (17.4%). The general seroprevalence of markers for HIV, HBV, HCV, and syphilis was 5 (2.5%); 26 (12.9%); 1 (0.5%) and 5 (2.5%), respectively. Data for specific TTI are shown in Table 2.

In the present study, 2 (1.0%) of the 35 infected donors were co-infected with two pathogenic agents. The proportion of HIV-Syphilis co-infection was 1 (0.5%); HBV-HCV 1 (0.5%).

TTIs was higher in females compared to males with 24.0% (6/25) vs 16.5% (29/176) but the difference was non-significant (p = 0.25). For HBV in particular, we have the same tendency with 16.0% (4/25) vs 12.5% (22/176), p = 0.41. This study reported a

higher seropositivity for the HBV marker rate among donors with non-formal education level with 37.5% (3/8) and primary level with 19.6% (10/51), than those with secondary 11.1% and university level 4.7%. These results show a significant difference (p = 0.02). Depending on the number of sexual partners, we observed a significant difference between donors (p <0.0001). the positivity rate increases with the number of sexual partners across the majority of markers (HBV, HIV and syphilis). 100% of donors with 3 sexual partners had at least one positive marker. According to age group, residence, occupation, marital status, there was no significant difference, the different rates are reported in Table 2.

There was no significant difference in seroprevalence according to type of donors (Table 3) and blood types (table 4).

Table 2. Prevalence of serologic markers for specific TTIs and relationship to demographic factors of blood donors attending the Garoua Regional Hospital Blood Bank

Sociodemographic Variable	Number of donors	Any TTI No (%)	HBsAg + ve No (%)	HCV + ve No (%)	HIV + ve No (%)	Anti –TP +ve No (%)
Sexe						
Male	176	29 (16.5)	22 (12.5)	1(0.6)	4 (2.3)	4 (2.3)
Female	25	6 (24.0)	4 (16.0)	0	1 (4.0)	1 (4.0)
p-value		*0.25*	*0.41*	*0.87*	*0.48*	*0.48*
Age Group						
≤25	45	6 (13.3)	6 (13.3)	0	0	0
26-35	103	20 (19.4)	13 (12.6)	1 (1.0)	5 (4.9)	3 (2.9)
36-50	46	9 (19.6)	7 (15.2)	0	0	2 (4.3)
>50	7	0	0	0	0	0
p-value		*0.60*	*0.89*		*0.34*	*0.51*
Educational Level						
Nonformal education level	8	3 (37.5)	3 (37.5)	0	0	0
Primary	51	12 (23.5)	10 (19.6)	0	2 (3.9)	0
Secondairy	99	15 (15.2)	11 (11.1)	1 (1.0)	2 (2.0)	3 (3.0)
University	43	5 (11.6)	2 (4.7)	0	1 (2.3)	2 (4.7)
p-value		*0.16*	***0.02***		*0.86*	*0.46*
Residence						
Rural	84	15 (17.9)	10 (11.9)	1 (1.2)	3 (3.6)	3 (3.6)
Urban	117	20 (17.1)	16 (13.7)	0	2 (1.7)	2 (1.7)
p-value		*0.51*	*0.44*	*0.41*	*0.34*	*0.34*
Occupation						
housewife	14	4 (28.6)	2 (14.3)	0	1 (7.1)	1 (7.1)
student	20	2 (10.0)	1 (5.0)	0	0	1 (5.0)
worker	167	29 (17.4)	23 (13.8)	1 (0.6)	4 (2.4)	3 (1.8)
p-value		*0.36*	*0.68*		*0.36*	*0.16*
Marital status						
Single	87	14 (16.1)	10 (11.5)	0	3 (3.4)	1 (1.1)
Married	114	21 (18.4)	16 (14.0)	1 (0.9)	2 (1.8)	4 (3.5)
p-value		*0.40*	*0.37*	*0.56*	*0.37*	*0.28*
Multiple partners						
0	13	2 (15.4)	2 (15.4)	0	0	0
1	171	17 (9.9)	15 (8.8)	1 (0.6)	1 (0.6)	1 (0.6)
2	10	9 (90.0)	6 (60.0)	0	1 (10.0)	2 (20.0)
3	7	7 (100.0)	3 (42.9)	0	3 (42.9)	2 (28.6)
		<0.0001	***<0.0001***		***<0.0001***	***<0.0001***

Note: P-value, Fisher's exact test to test statistical difference only for 2 × 2 tables, "+ve" positive, Any TTI Blood unit's positive for at least one of the tested transfusion transmissible infections

Table 3. Seroprevalence of TTI among replacement and Voluntary Blood donors at the Garoua Regional Hospital Blood Bank

Type of donor	Number of donors	Any TTI No (%)	HBsAg + ve No (%)	HCV + ve No (%)	HIV + ve No (%)	Anti –TP +ve No (%)
FRBD	180	32 (17.6)	24 (13.2)	1 (0.5)	4 (2.2)	5 (2.7)
VNRBD	2	1 (50.0)	1 (50.0)	0	0	0
RBD	19	2 (10.5)	1 (5.3)	0	1 (5.3)	0
p-value		*0.26*	*0.23*		*0.42*	

Note: P-value, Fisher's exact test to test statistical difference FRBD family replacement blood donors, VNRBD voluntary non-remunerated blood donors, RBD remunerated blood donors, "+ve" positive, Any TTI Blood units positive for at least one of the tested transfusion transmissible infections

Table 4: Distribution of blood-borne pathogens by donor blood type among blood donors in Garoua Regional Hospital Blood Bank

Blood type	Number of donors	Any TTI No (%)	HBsAg + ve No (%)	HCV + ve No (%)	HIV + ve No (%)	Anti –TP +ve No (%)
Blood group						
A	54	9 (16.7)	5 (9.3)	0	3 (5.6)	2 (3.7)
AB	10	2 (20.0)	2 (20.0)	0	0	0
B	57	8 (14.0)	6 (10.5)	0	2 (3.5)	0
0	80	16 (20.0)	13 (16.3)	1 (1.3)	0	3 (3.8)
p-value		*0.81*	*0.48*		*0.13*	*0.53*
RH blood group						
Negative	9	1 (11.1)	1 (11.1)	0	0	0
Positive	192	34 (17.7)	25 (13.0)	1 (0.5)	5 (2.6)	5 (2.6)
p-value		*0.51*	*0.67*	*0.95*	*0.79*	*0.79*

Note: P-value, Fisher's exact test to test statistical difference only for 2 × 2 tables, "+ve" positive, Any TTI Blood unit's positive for at least one of the tested transfusion transmissible infections

DISCUSSION

Our study aimed to investigate the prevalence and distribution of serologic markers of TTIs, in particular, anti-HIV, HBsAg, anti-HCV, and anti-*T. palladium* among blood donors attending the GRHBB. The issue of blood availability remains a challenge for all health structures. Securing this transfusion involves screening for transfusion transmittable infection markers, in particular, anti-HIV, HBV surface antigen (HBsAg), anti-HCV, and anti-*T. palladium*. We used sensitive rapid tests in series and a confirmatory test (ELISA) in accordance with the national algorithm for 2nd referral structures at the regional level [13], to determine the presence or absence of TTIs markers in donors. All enrolled donors gave their consent and good laboratory practices were scrupulously observed. The current study is the first to document addressed on the seroprevalence of TTIs among blood donors in the North Region of Cameroon, at the GRHBB. TTIs are prevalent in Cameroon, some of which more prevalent than others in northern regions. The viral markers of hepatitis B (HBsAg), HIV, and HCV seroprevalence within the population are, respectively, 21.53%, 0.60%, 1.6% [20]–[22]. A high risk of transmission of TTIs has been reported in developing countries [18].

The study included 201 donors; many being family replacement blood donors (89.55%), while voluntary non-remunerated blood donors were approximately 0.1 %. This was far from the WHO advocated rate of 80% [2]. Therefore a lot of efforts are still needed to improve VNRBD through sensitisation of population in Northern Cameroon. Family donors were more represented because they donate for acquaintances (friends, colleague) in urgent needs, similar to what was also reported in Douala Cameroon by Eboumbou Moukoko et al [17] and in Tanzania [35].

The number of male donors was higher than that of female donors (87.56% vs 12.44%), with a sex ratio of 7.0, a finding consistent with other reports [36], [17]. Female had more counter indication for blood donation than men.

This study indicated a high seroprevalence of TTIs, HBsAg, HCV, HIV and syphilis, which were, respectively, 12.9%, 0.5%, 2.5% and 2.5% in donors attending GRHBB. HBsAg marker was the most prevalent among blood donors in Garoua with 12.9%. in agreement with other studies in Cameroon, from Ymele et al. at Youndé Central Hospital

which revealed a 12.14% prevalence [28], from Noah at the same hospital with 10.8% [32], and from Noubiap at Edea with 10.1% prevalence [25]. The high prevalence of hepatitis B can be the consequence of its prevalence at Garoua general population with 21.53% [20], and in specific group like pregnant women as reported (20.4%) by Ducancelle et al [37]. Hepatitis B infection is endemic in Garoua. The North and Far North regions have been reported to record the highest prevalence at the national level compared to other regions in Cameroun [20]. This high prevalence could be attributed to risk factors underlined by Fritzsche et al., such as: illiteracy, low level of exposure to the media, polygamy and multiple sex partners, ineffective use of condoms, lack of prenatal care, and the practice of some traditional rites and beliefs [38].

The prevalence of the HBsAg marker in the research appears to be higher than expressed by Dionne-odom et al. in bamenda with 6.8% [27], Samje et al. in the same locality with 4.7% [24], and that of Eboumbou et al. in Douala with 3.5% [17].

HBsAg was also reported among blood donors in other African countries, varying with studies and countries, ranging from 2.4% to 9.5% in Ethiopia [39]–[42], 5.57% in Sudan [43], and 18.6% in Nigeria [36].

Age and educational level (p=0.6) were not significantly associated with HBV infection. As a matter of fact, no statistically significant difference was found between individuals in the different age categories. However, in terms of education level, the probability of having an HBV infection was higher in individuals with non-formal education level (37.5%) compared to people with a higher education level (4 .6%). This could be due to the fact that people with a high education level better understand sensitizations and put them into practice.

Concerning the HIV, the seroprevalence in our study was 2.5%, thus remaining higher than those previously reported by Eboumbou in Douala (1.8%) [17], Dionne-odom et al. (2.2%) [27], and Samje et al. (2.2%) in Bamenda [24]; but lower than those by Ymele et al. (4.44%) [28], and Noubiap et al. (4.1%) [25]. Moreover, this prevalence rate was low when compared to the results in a study conducted by Mayomo Fohoue, et al at the Central Hospital of Yaoundé which was 5.4% [44]. This decline could be explained by the impact of public awareness campaigns on the prevention of HIV / AIDS. The prevalence of HIV in the general population was also shown to be among the lowest in Cameroun (1.7%) [21]. The number of sexual partners was significantly associated with HIV infection (P=0.00) as sex intercourse is known to be the main route of transmission.

The HCV seroprevalence was 0.5% among all blood donors, which appears to be low compared to other studies conducted in Cameroun in which prevalences ranged from 1.3% to 4.8% [17], [24], [25], [27], [28]. Our prevalence of HCV marker was similar to results found by Abdella (0.4%) [39], and close to those of Biadgo (0.8%) [41], in Ethiopia.

We found a seroprevalence of 2.5% syphilis among all blood donors in accodance to those reported by Samje with 2.2% [24] lower than those from other studies in Cameroun [17], [25], [27], Sudan [43], Ethiopia[40] and Tchad [45]; but higher than the studies by Buseria et al. in Nigeria [36], Abdella et al. in Ethiopia [39], and Alharazi et al. in Yemen [46].

In our study, the sero-prevalence was higher in women (4%) compared to men (2.2%), but this difference was not significant enough (P = 0.6) The most infected age group was [26-50[with 3.35% this preponderance that could be explained by the fact that this category was the most sexually active.

Regarding co-infections we had: HIV-syphilis and HBV-HCV during our study, with respective frequencies of 0.5% and 0.5% found in all donors. The prevalence of HIV-Syphilis coinfection was lower than those observed by Noubiap et al. (1.10%) [25]. Similarly, with regard to the co-infection with HBV-HCV, Ymele et al. observed a prevalence of 0.21% [28].

CONCLUSIONS

at the end of this study, which aimed at determining the seroprevalence of TTIs markers among blood donors at the Garoua Regional Hospital Blood Bank. The seroprevalence of HBsAg is alarming among other infectious markers. Deciders must take measures to fight this health threat, and more sensitization on voluntary blood donation is needed to fill the gap in the required pints of blood for patients in Garoua.

DATA AVAILABILITY

Our data may be available upon request.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding Statement

No specific funding was received. Employer: Ministry of Public Health of Cameroon.

Acknowledgments

The authors are grateful to the National Program of Blood Transfusion under the direction of the Ministry of Public Health and the Blood Bank of the Garoua Regional Hospital.

REFERENCES

I. World Health Organization, « Model List of Essential Medicines for Children 7th List ». World Health Organization, 2019.

II. A. Loua, J. Nikiema, O. Kasilo, et C. T. Tagny, « Blood safety and availability in the WHO African region », *Glob Surg*, vol. 4, nº 4, 2018, doi: 10.15761/GOS.1000189.

III. C. T. Tagny *et al.*, « Updated characteristics of blood services, donors and blood products in 11 French-speaking African countries », *Vox Sang*, vol. 113, nº 7, p. 647-656, oct. 2018, doi: 10.1111/vox.12702.

IV. B. Custer *et al.*, « Addressing gaps in international blood availability and transfusion safety in low- and middle-income countries: a NHLBI workshop: BLOOD AVAILABILITY AND TRANSFUSION SAFETY IN LMICs », *Transfusion*, vol. 58, nº 5, p. 1307-1317, mai 2018, doi: 10.1111/trf.14598.

V. R. Idro et J. Aloyo, « Manifestations, Quality of Emergency Care and Outcome of Severe Malaria in Mulago Hospital, Uganda », *African Health Sciences*, vol. 4, nº 1, p. 8, 2004.

VI. G. B. Scott, S. B. Brogly, D. Muenz, A. M. Stek, J. S. Read, et for the International Maternal Pediatric Adolescent AIDS Clinical Trials Group (IMPAACT) P1025 Study Team, « Missed Opportunities for Prevention of Mother-to-Child Transmission of Human Immunodeficiency Virus », *Obstetrics & Gynecology*, vol. 129, nº 4, p. 621-628, avr. 2017, doi: 10.1097/AOG.0000000000001929.

VII. S. Kiguli *et al.*, « Anaemia and blood transfusion in African children presenting to hospital with severe febrile illness », *BMC Med*, vol. 13, nº 1, p. 21, déc. 2015, doi: 10.1186/s12916-014-0246-7.

VIII. E. M. Bloch, M. Vermeulen, et E. Murphy, « Blood Transfusion Safety in Africa: A Literature Review of Infectious Disease and Organizational Challenges », *Transfusion Medicine Reviews*, vol. 26, nº 2, p. 164-180, avr. 2012, doi: 10.1016/j.tmrv.2011.07.006.

IX. A. Fisher, S. Wallis, O. Hassall, R. Martin, et I. Bates, « Collaborations on blood transfusion research in sub-Saharan Africa: who, what and where », *Vox Sang*, vol. 115, nº 3, p. 221-232, avr. 2020, doi: 10.1111/vox.12884.

X. E. E. Dogbe et F. Arthur, « Diagnostic accuracy of blood centers in the screening of blood donors for viral markers », *Pan Afr Med J*, vol. 20, 2015, doi: 10.11604/pamj.2015.20.119.5263.

XI. C. T. Tagny *et al.*, « Transfusion safety in francophone African countries: an analysis of strategies for the medical selection of blood donors: TRANSFUSION SAFETY IN FRANCOPHONE AFRICAN COUNTRIES », *Transfusion*, vol. 52, nº 1, p. 134-143, janv. 2012, doi: 10.1111/j.1537-2995.2011.03391.x.

XII. .W. Fong, « Blood Transfusion-Associated Infections in the Twenty-First Century: New Challenges », in *Current Trends and Concerns in Infectious Diseases*, Cham: Springer International Publishing, 2020, p. 191-215. doi: 10.1007/978-3-030-36966-8_8.

XIII. C. T. Tagny et D. Mbanya, « Manuel pratique du laboratoire de Transfusion Sanguine dans les Pays en développement », *Croix-Rouge de Belgique*, p. 141, 2013.

XIV. C. E. Eboumbou Moukoko, F. Ngo Sack, E. G. Essangui Same, M. Mbangue, et L. G. Lehman, « HIV, HBV, HCV and T. palliduminfections among blood donors and Transfusion-related complications among recipients at the Laquintinie hospital in Douala, Cameroon », *BMC Hematol*, vol. 14, nº 1, p. 5, déc. 2014, doi: 10.1186/2052-1839-14-5.

XV. M. Kengne, D. C. Wouado Tsata, T. Ndomgue, et J. Mbekem Nwobegahay, « Prevalence and risk factors of HTLV-1/2 and other blood borne infectious diseases among blood donors in Yaounde Central Hospital, Cameroon », *Pan Afr Med J*, vol. 30, 2018, doi: 10.11604/pamj.2018.30.125.14802.

XVI. F. Chabrol *et al.*, « Screening, diagnosis and care cascade for viral hepatitis B and C in Yaoundé, Cameroon: a qualitative study of patients and health providers coping with uncertainty and unbearable costs », *BMJ Open*, vol. 9, nº 3, p. e025415, mars 2019, doi: 10.1136/bmjopen-2018-025415.

XVII. C. E. Eboumbou Moukoko, F. Ngo Sack, E. G. Essangui Same, M. Mbangue, et L. G. Lehman, « HIV, HBV, HCV and T. palliduminfections among blood donors and Transfusion-related complications among recipients at the Laquintinie hospital in Douala, Cameroon », *BMC Hematol*, vol. 14, nº 1, p. 5, déc. 2014, doi: 10.1186/2052-1839-14-5.

XVIII. C. T. Tagny, A. Ndoumba, S. Laperche, E. Murphy, et D. Mbanya, « Reducing risks of Transfusion-transmitted infections in a resource-limited hospital-based blood bank: the case of the Yaoundé University Teaching Hospital, Cameroon », *VOXS*, vol. 11, nº 2, p. 82-87, août 2016, doi: 10.1111/voxs.12287.

XIX. World Health Organization, « Screening donated blood for transfusion-transmissible infections : recommendations », *World Health Organization*, p. 66, 2009, Consulté le: 10 septembre 2022. [En ligne]. Disponible sur: https://apps.who.int/iris/handle/10665/44202

XX. D. N. Noah, F. A. Andoulo, B. V. M. Essoh, G. N. Ayissi, S. A. F. E. Bagnaka, et M. B. Sida, « Prevalence of HBs Antigen, and HCV and HIV Antibodies in a Young Male Population in Cameroon », *OJGas*, vol. 05, nº 12, p. 185-190, 2015, doi: 10.4236/ojgas.2015.512028.

XXI. National Institute of Statistics, « Cameroon population-based HIV impact assessment Camphia

2017 », National Institute of Statistics, Cameroon, juill. 2018.

XXII. National Institute of Statistics, « Cameroon Demographic and Health Survey », National Institute of Statistics, Cameroon, Summary Report, 2018.

XXIII. C. Kengne-Nde *et al.*, « Highlighting a population-based re-emergence of Syphilis infection and assessing associated risk factors among pregnant women in Cameroon: Evidence from the 2009, 2012 and 2017 national sentinel surveillance surveys of HIV and syphilis », *PLoS ONE*, vol. 15, nº 11, p. e0241999, nov. 2020, doi: 10.1371/journal.pone.0241999.

XXIV. M. Samje *et al.*, « Trends in serological markers of transfusion transmissible infections in blood donations at the Bamenda Hospital-based Blood Service, Cameroon », *Transfusion Clinique et Biologique*, vol. 28, nº 3, p. 228-233, août 2021, doi: 10.1016/j.tracli.2021.05.011.

XXV. J. J. N. Noubiap, W. Y. A. Joko, J. R. N. Nansseu, U. G. Tene, et C. Siaka, « Sero-epidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon », *International Journal of Infectious Diseases*, vol. 17, nº 10, p. e832-e837, oct. 2013, doi: 10.1016/j.ijid.2012.12.007.

XXVI. D. Mbanya, M. Sama, et P. Tchounwou, « Current Status of HIV/AIDS in Cameroon: How Effective are Control Strategies? », *Int. J. Environ. Res. Public Health*, p. 6, 2008.

XXVII. J. Dionne-Odom *et al.*, « Hepatitis B, HIV, and Syphilis Seroprevalence in Pregnant Women and Blood Donors in Cameroon », *Infectious Diseases in Obstetrics and Gynecology*, vol. 2016, p. 1-8, 2016, doi: 10.1155/2016/4359401.

XXVIII. F. Fouelifack Ymele, B. Keugoung, J. H. Fouedjio, N. Kouam, S. Mendibi, et J. Dongtsa Mabou, « High Rates of Hepatitis B and C and HIV Infections among Blood Donors in Cameroon: A Proposed Blood Screening Algorithm for Blood Donors in Resource-Limited Settings », *Journal of Blood Transfusion*, vol. 2012, p. 1-7, oct. 2012, doi: 10.1155/2012/458372.

XXIX. M. L. Koanga Mogtomo, L. P. Kojom Foko, E. V. Assokom Okoubalimba, E. E. Enyegue, et A. R. Ngono Ngane, « High Risk of Transfusion-Transmitted Malaria (TTM) from Student Blood Donors Living in the Town of Douala, Cameroon », *J Clin Infect Dis Pract*, vol. 01, nº 01, 2016, doi: 10.4172/2476-213X.1000108.

XXX. M. Loriette *et al.*, « An experience of hepatitis B control in a rural area in Far North Cameroon », *Médecine et Santé Tropicales*, vol. 25, nº 4, p. 422-427, oct. 2015, doi: 10.1684/mst.2015.0507.

XXXI. C. N. Funeh *et al.*, « Seroprevalence of hepatitis B virus among people screened at a primary care hospital in Bamenda: a cross-sectional study », p. 8.

XXXII. D. Noah Noah, R. Njouom, A. Bonny, P. Pirsou, J. Meli, et M. B. Sida, « HBs antigene prevalence in blood donors and the risk of transfusion of hepatitis b at the central hospital of yaounde, cameroon », *OJGas*, vol. 01, nº 02, p. 23-27, 2011, doi: 10.4236/ojgas.2011.12004.

XXXIII. J. J. N. Noubiap, W. Y. A. Joko, J. R. N. Nansseu, U. G. Tene, et C. Siaka, « Sero-epidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon », *International Journal of Infectious Diseases*, vol. 17, nº 10, p. e832-e837, oct. 2013, doi: 10.1016/j.ijid.2012.12.007.

XXXIV. B. Gake *et al.*, « Low seroprevalence of Zika virus in Cameroonian blood donors », *The Brazilian Journal of Infectious Diseases*, vol. 21, nº 4, p. 481-483, juill. 2017, doi: 10.1016/j.bjid.2017.03.018.

XXXV. M. I. Matee, P. M. Magesa, et E. F. Lyamuya, « Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis infections among blood donors at the Muhimbili National Hospital in Dar Es Salaam, Tanzania », *BMC Public Health*, p. 6, 2006.

XXXVI. F. I. Buseri, M. A. Muhibi, et Z. A. Jeremiah, « Sero-epidemiology of transfusion-transmissible infectious diseases among blood donors in Osogbo, South-West, Nigeria », *Blood Transfusion*, 2009, doi: 10.2450/2009.0071-08.

XXXVII. A. Ducancelle *et al.*, « High Endemicity and Low Molecular Diversity of Hepatitis B Virus Infections in Pregnant Women in a Rural District of North Cameroon », *PLoS ONE*, vol. 8, nº 11, p. e80346, nov. 2013, doi: 10.1371/journal.pone.0080346.

XXXVIII. C. Fritzsche *et al.*, « Hepatitis B and C: neglected diseases among health care workers in Cameroon », *Transactions of The Royal Society of Tropical Medicine and Hygiene*, p. 158-64, mars 2013. Consulté le: 21 septembre 2022. [En ligne]. Disponible sur: https://academic.oup.com/trstmh/article-lookup/doi/10.1093/trstmh/trs087

XXXIX. S. Abdella *et al.*, « Sero-prevalence of transfusion transmittable infections: HIV, Hepatitis B, C and Treponema pallidum and associated factors among blood donors in Ethiopia: A retrospective study », *PLoS ONE*, vol. 15, nº 10, p. e0241086, oct. 2020, doi: 10.1371/journal.pone.0241086.

XL. F. S. Bisetegen, F. B. Bekele, T. A. Ageru, et F. W. Wada, « Transfusion-Transmissible Infections among Voluntary Blood Donors at Wolaita Sodo University Teaching Referral Hospital, South Ethiopia », *Canadian Journal of Infectious Diseases and Medical Microbiology*, vol. 2016, p. 1-6, 2016, doi: 10.1155/2016/8254343.

XLI. B. Biadgo, E. Shiferaw, B. Woldu, K. A. Alene, et M. Melku, « Transfusion-transmissible viral infections among blood donors at the North Gondar district blood bank, northwest Ethiopia: A three year retrospective study », *PLoS ONE*, vol. 12, nº 7, p. e0180416, juill. 2017, doi: 10.1371/journal.pone.0180416.

XLII. M. Negash, M. Ayalew, D. Geremew, et M. Workineh, « Seroprevalence and associated risk factors for HIV, Hepatitis B and C among blood Donors in South Gondar District blood Bank, Northwest Ethiopia », *BMC Infect Dis*, vol. 19, nº 1, p. 430, déc. 2019, doi: 10.1186/s12879-019-4051-y.

XLIII. E. B. Ahmed, A. A. Essa, B. S. Almugadam, Q. M. Ahmed, et M. M. Hussein, « Transfusion transmitted infections among male blood donors of White Nile State, Sudan: Screening of the current seroprevalence and distribution », *BMC Res Notes*, vol. 13, nº 1, p. 549, déc. 2020, doi: 10.1186/s13104-020-05333-6.

XLIV. A. Mayomo Fohoue, F. Ngo Sack, C. Tchinda Fossi, A. Fossi, et Y. Bassong Olga, « Prévalence des Infections Transmissibles par Transfusion Sanguine chez les Donneurs de Sang à l'Hôpital Central de Yaoundé - Cameroun », *Health Science Disease*, vol. 20, p. 6, 2019.

XLV. D. M. Doungous *et al.*, « Prévalence de la syphilis chez les donneurs de sang à la Banque du Sang d'Abéché au Tchad », *Int. J. Bio. Chem. Sci*, vol. 14, nº 3, p. 1085-1092, juin 2020, doi: 10.4314/ijbcs.v14i3.34.

XLVI. T. Alharazi *et al.*, « Prevalence of Transfusion-Transmitted Infections (HCV, HIV, Syphilis and Malaria) in Blood Donors: A Large-Scale Cross-Sectional Study », *Pathogens*, vol. 11, nº 7, p. 726, juin 2022, doi: 10.3390/pathogens11070726.