Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis among blood donors in Koudougou (Burkina Faso) in 2009

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Background. The high prevalence of numerous transfusion-transmitted infectious diseases such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis in sub-Saharan Africa affects the safety of blood for recipients. This study was undertaken with the aim of determining the seroprevalence of HIV, HCV, HBV, syphilis and socio-demographic risk factors associated with blood donation in a new regional blood transfusion centre in Burkina Faso.

Material and methods. Sera samples were screened for hepatitis B surface antigen (HBsAg), antibodies to HCV, HIV types 1 and 2 and to *Treponema pallidum* using enzyme-linked immunosorbent assays and Rapid Plasma Reagin test (RPR) respectively. All the reactive samples for HIV, HBsAg, and HCV were confirmed using a second enzyme-linked immunosorbent assays. Antibodies to *Treponema pallidum* were confirmed with a *Treponema pallidum* haemagglutination test (TPHA).

Results. From the total of 4,520 blood donors in 2009, 1,348 (29.82%) were infected with at least one pathogen and 149 (3.30%) had serological evidence of multiple infections. The overall seroprevalence rate of HIV, HBV, HCV and syphilis was 2.21%, 14.96%, 8.69% and 3.96%, respectively. Among blood donors with multiples infections, the most common dual or triple combinations were HBsAg-HCV (1.39%), HBsAg-syphilis (0.66%) and HBsAg-HCV-syphilis (0.11%). The highest prevalences of HBsAg and HIV were found among blood donors from rural areas and in the age groups of 20-29 years and >40 years old, respectively.

Conclusion. HBV and HCV remain the greatest threats to blood safety in Burkina Faso. Strict selection and retention of voluntary, non-remunerated low-risk blood donors are recommended to improve blood safety in the regional blood transfusion centre of Koudougou.

Keywords: transfusion, blood donors, HBV, HCV, Burkina Faso.

Introduction

Blood safety remains a major public health problem in sub-Saharan Africa because of inadequacies of national blood transfusion policies and services, appropriate infrastructures, qualified personnel and financial resources[1].

There are different systems for blood supply in Africa. The National Blood Transfusion Centre of Burkina Faso (CNTS) has opted for a centralised system that recruits non-remunerated voluntary donors. The CNTS has four regional blood transfusion centres, which are based at Ouagadougou, Bobo-Dioulasso, Koudougou and Fada N'gourma. The backbone of a well-organised blood transfusion service is the recruitment and retention of voluntary, non-remunerated, low-risk blood donors[2]. Screening for transfusion-transmissible infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis is also essential for blood transfusion safety and, in extension, for protecting human life[3].

Transfusion of infected blood is the cause of

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5-10% of HIV infections in sub-Saharan Africa[4] and 12.5% of patients who receive blood transfusions are at risk of post-transfusion hepatitis[5]. In Burkina Faso, the prevalence of HBV (14.3%)[6] and HCV (5.2%)[7] is high, with local variations. In 2007 the prevalence of HIV in the general population was estimated to be 1.6%[8] and the seroprevalence of syphilis among blood donors was established to be 1.6%[7].

Given the regional variation in transfusion-transmitted infections, the aim of this study was to evaluate the seroprevalence of HIV, HBV, HCV and syphilis among blood donors in the recently opened regional blood transfusion centre of Koudougou (established in 2008) in Burkina Faso, with a view to possible implementation of its blood transfusion safety strategies.

Materials and methods

Serological analysis

Hepatitis B surface antigen (HBsAg), antibodies to Treponema pallidum and HCV were detected using Hepanostika HBsAg Ultra (Biomérieux, Boxtel, The Netherlands), Rapid Plasma Reagin test (RPR) (Cypress Diagnostics, Langdorp, Belgium) and Hepanostika HCV Ultra (Beijing United Biomedical Co. Ltd., Beijing, China), respectively. Antibodies to HIV types 1 and 2 were screened for using Vironostika HIV Uni-Form II Ag/Ab (Biomérieux, Boxtel, The Netherlands).

All the samples reactive for HIV, HBsAg, and HCV were re-tested for confirmation using a second enzyme-linked immunosorbent assay (Bio-Rad, Marnes la Coquette, France). The presence of antibodies to *Treponema pallidum* was confirmed with a *Treponema pallidum* haemagglutination test (TPHA, Cypress Diagnostics, Belgium). A result was considered positive if both the first and second tests were positive.

ABO blood grouping and Rhesus typing

ABO and Rhesus (Rh) blood groups were determined using blood grouping anti-sera: anti-A, anti-B, anti-AB, and anti-D (Cypress Diagnostics, Belgium).

Subjects studied

A retrospective analysis of blood donor data from January to December 2009 was conducted in the regional blood transfusion centre of Koudougou (the third most populated city in Burkina Faso, after Ouagadougou and Bobo-Dioulasso). The city is located 75 km from Ouagadougou, on the railway linking the capital of Burkina Faso to the Ivory Coast capital Abidjan. The city had 73,300 inhabitants in 1995.

Voluntary donors were all apparently healthy subjects, selected after responding to a panel of questions comprising a medical history. Apparently healthy individuals aged 17-64 years with a weight >50 kg, were included for blood donation. The socio-demographic characteristics of the selected donors were recorded in a database and venous blood was collected in blood banking bags following standard procedures.

This study was approved by the CERBA/Saint Camille Ethics Committee. However, because of the retrospective nature of the study, informed consent was not obtained from the study subjects.

Table I - Socio-demographic characteristics of blood donors from Koudougou in 2009.

Characteristics	Total	Type of donors	
		First-time donors	Repeat donors
	N (%)	N (%)	N (%)
Gender			
Male	3,418 (75.62)	3,073 (89.91)	345 (10.09)
Female	1,102 (24.38)	1,028 (93.28)	74 (6.72)
Age group (years)			
<20	1,177 (26.04)	1,100 (93.46)	77 (6.54)
20-29	2,730 (60.40)	2,461 (90.15)	269 (9.85)
30-40	424 (9.38)	363 (85.61)	61 (14.39)
>40	189 (4.18)	177 (93.65)	12 (6.35)
Place of blood collection			
Urban areas	3,005 (66.48)	2,624 (87.33)	381 (12.67)
Rural areas	1,515 (33.52)	1,477 (97.49)	38 (2.51)
Blood groups			
O	1,944 (43.01)	1,737 (89.35)	207 (10.65)
A	1,106 (24.47)	1,018 (92.04)	88 (7.96)
B	1,206 (26.68)	1,103 (91.46)	103 (8.54)
AB	264 (5.84)	243 (92.05)	21 (7.95)
Rhesus (Rh) type			
Positive	4,179 (92.46)	3,795 (90.81)	384 (9.19)
Negative	341 (7.54)	306 (89.74)	35 (10.26)
All	4,520 (100)	4,101 (90.73)	419 (9.27)

Statistical analysis

Data were analysed using EPI-Info version 6.04 dfr (CDC, Atlanta, USA). Odds ratio were calculated to determine risk factors associated with HIV, HBV, HCV and syphilis. P values below 0.05 were considered statistically significant.

Results

Demographic characteristics of the blood donors

As shown in Table I, 4,520 blood donors were screened at Koudougou in 2009. Of all donors, 2,730 (60.40%) were in the age group of 20-29 years. The mean age of the study subjects was 24 years (range, 17-64 years). Overall, 3,418 (75.62%) donors were male and 1,102 (24.38%) were female, 419 (9.27%) were repeat donors, 1,944 (43.01%) were blood group O and 4,179 (92.46%) were RhD-positive. The majority of blood donors (66.48%) were recruited in urban areas; likewise, more repeat donors were recruited in urban areas than in rural areas. The proportion of repeat donors was highest in the age group from 30-40 years old.

Overall seroprevalence of HIV, HBsAg, HCV, syphilis and multiple infections among blood donors

The overall seroprevalence of HIV, HBsAg, HCV and syphilis was 2.21%, 14.96%, 8.69% and 3.96%, respectively. Of all blood donors in 2009, 1,348 (29.82%) were infected with at least one pathogen and 149 (3.30%) had serological evidence of multiple infections. The overall prevalence of HBsAg-HCV, HBsAg-syphilis, HIV-HBsAg, HCV-syphilis and HBsAg-HCV-syphilis was 1.39%, 0.66%, 0.38%, 0.31% and 0.11%, respectively. The most common co-infections among blood donors were HBsAg-HCV and HBsAg-syphilis (Table II).

Table II - Prevalence of co-infections of HIV, HBV, HCV and syphilis among blood donors from Koudougou in 2009.

Co-infections	Number	Percentage
HIV-HBsAg	17	0.38
HIV-HCV	14	0.31
HIV-Syphilis	2	0.04
HBsAg -HCV	63	1.39
HBsAg -Syphilis	30	0.66
HCV-Syphilis	14	0.31
HBsAg -HCV-Syphilis	5	0.11
HIV- HBsAg -Syphilis	1	0.02
HIV-HCV-Syphilis	2	0.04
HIV- HBsAg -HCV	1	0.02
Total	149	3.30

Seropositivity for HIV and syphilis among blood donors

The seroprevalence of HIV was higher among donors in the age group of >40 years than in the age group 30-40 years old (P=0.037) and significantly higher among donors from rural areas than among donors from urban areas (P<0.001) (Table III).

The seroprevalence of syphilis was significantly higher among male blood donors than among female donors (P=0.005) (Table III).

Seroprevalence of HBV and HCV among blood donors

The seroprevalence of HBV was significantly higher among male blood donors than among female donors (P<0.001) and also higher among donors in the group aged 20-29 years old than in the group 30-40 years old (P=0.015) (Table III). A significantly higher seroprevalence of HBV was observed among donors from rural areas (P<0.001) and first-time donors (P<0.001) compared to donors from urban areas and repeat donors, respectively (Table III).

The seroprevalence of HCV was higher among the youngest age group (less than 20 years old; P<0.001) and in subjects >40 years (P=0.005) compared to the prevalence in subjects in the age group 30-40 years old. The seroprevalence of HCV was equivalent among donors from urban and rural areas (Table III).

Discussion

In this study, we determined the overall prevalence of various transfusion-transmissible diseases in blood donors giving blood at a regional blood transfusion centre in Burkina Faso. The prevalence of HIV was 2.21%, that of HBsAg was 14.96%, that of HCV 8.69% and that of syphilis 3.96%.

The higher prevalence of HIV that we found among blood donors from rural areas is in discordance with a previous report in which the prevalence of HIV was higher in urban areas than in rural areas in Burkina Faso[9]. The prevalence of HIV found in this study is lower than the 2.9% and 3.8% seroprevalence level found in Cameroon and Ghana, respectively[10,11]. The HIV seropositivity rate was identical among female and male donors and among first-time blood donors and repeat blood donors. These findings are also in discordance with those of previous studies[1,12,13]. Furthermore, the seroprevalence of HIV

Table III - Socio-demographic characteristics of blood donors at Koudougou according to HIV, syphilis, HBV and HCV infection.

Characteristics	Total N	HIV positive N (%)	OR (95% CI)	P-values	Syphilis positive N (%)	OR (95% CI)	P-values	HBV positive N (%)	OR (95% CI)	P-values	HCV positive N (%)	OR (95% CI)	P-values
Gender													
Male	3,418	78 (2.28)	1.15 (0.70-1.90)	0.575	309 (9.04)	1.77 (1.16-2.73)	0.005	549 (16.06)	1.47 (1.19-1.82)	**<0.001**	309 (9.04)	1.20 (0.93-1.56)	0.146
Female	1,102	22 (2.00)	1.00	-	84 (7.62)	1.00	-	127 (11.52)	1.00	-	84 (7.62)	1.00	-
Age group (years)													
<20	1,177	23 (1.95)	1.67 (0.60-5.04)	0.297	124 (10.54)	1.15 (0.63-2.14)	0.622	168 (14.27)	1.30 (0.91-1.86)	0.127	124 (10.54)	2.20 (1.37-3.75)	**<0.001**
20-29	2,730	65 (2.38)	2.04 (0.79-5.79)	0.118	176 (6.45)	1.01 (0.58-1.80)	0.971	434 (15.90)	1.48 (1.07-2.06)	**0.015**	176 (6.45)	1.32 (0.81-2.17)	0.237
30-40	424	5 (1.18)	1.00	-	21 (4.95)	1.00	-	48 (11.32)	1.00	-	21 (4.25)	1.00	-
>40	189	7 (3.70)	3.22 (0.91-11.85)	**0.037**	21 (11.11)	1.13 (0.43-2.86)	0.787	26 (13.76)	1.25 (0.73-2.14)	0.393	21 (11.11)	2.40 (1.22-4.71)	**0.005**
Place of blood collection													
Urban areas	3,005	49 (1.63)	1.00	-	259 (8.62)	1.00	-	392 (13.04)	1.00	-	259 (8.62)	1.00	-
Rural areas	1,515	49 (3.23)	2.02 (1.33-3.07)	**0.001**	134 (8.84)	1.03 (0.82-1.29)	0.835	284 (18.75)	1.54 (1.30-1.82)	**<0.001**	134 (8.84)	1.03 (0.82-1.29)	0.835
Type of donor													
First-time donors	4,101	96 (2.34)	2.49 (0.88-7.98)	0.066	366 (8.92)	1.76 (0.90-3.56)	0.083	653 (15.92)	3.26 (2.09-5.13)	**< 0.001**	366 (8.92)	1.42 (0.93-2.18)	0.086
Repeat donors	419	4 (0.95)	1.00	-	27 (6.44)	1.00	-	23 (5.49)	1.00	-	27(6.44)	1.00	-

OR= Odds Ratio; CI= Confidence Interval; Urban areas = Blood centre, Townships, Schools and Universities; significant P values are shown in bold.

was significantly lower among blood donors aged between 30 and 40 years old (1.18%) compared to that in subjects over 40 years old (3.70%). This finding contrasts with a recently reported reduction of HIV prevalence among young people in Africa[14].

In this study, the prevalence of HBsAg was 14.96%. The high seroprevalence of HBsAg found at Koudougou could be explained by the blood donors' provenience. Indeed, 33.52% of these blood donors are from rural areas and the prevalence of HBV among such donors is 18.75% (Table III). Another reasonable explanation could be the marked use of tattooing among the Mossi, Gourounsi and Bobo, the major ethnic groups in the Koudougou region. This is consistent with the results of previous studies in which higher prevalences of HBV were found in rural areas than in urban areas[15,16] and a study showing that tattooing is a risk factor for HBV transmission[17]. The prevalence of HBV found at Koudougou is equivalent to the 15% observed in Ghana[10], while it is lower than the 7.51% HBV seroprevalence reported in Benin[18]. The seroprevalence of HBV was significantly higher among male and first time blood donors than among female and repeat blood donors, respectively. A lower prevalence of HBV among repeat donors could be explained by the donor's low-risk profile for HBV infection through repeated selection[19]. The higher rate of HBV seropositivity found in the group of subjects aged 20 to 29 years old was in agreement with the findings of a previous study[20]. This high prevalence of HBV in youth suggests a potential public health problem. Seropositivity for HBsAg may progress towards liver cirrhosis and hepatocarcinoma in some cases.

The prevalence of HCV was 8.69%. This prevalence of HCV observed among blood donors from Koudougou is higher than values ranging between 0.072% and 0.6% reported from the USA and Europe[21,22]; while it is lower than the 12.3% prevalence reported among blood donors from Nigeria[23]. The prevalence of HCV was similar among male and females donors and among first-time blood donors and repeat donors. This differs from the findings of Buseri *et al*.[12]. Subjects aged less than 20 years and those over 40 years had significantly higher rates of HCV seropositivity while, interestingly, a lower prevalence of HCV was found among donors in the age group 30-40 years old. This finding could be explained by the high proportion of repeat donors among donors from this age group.

The seroprevalence of syphilis (3.96%) in this study was lower than the prevalence of 6.4% among blood donors in Tanzania[24], but higher than the 0.1% observed in Nigeria[20]. The highest seroprevalence rates of syphilis of 12.8% and 12.7% were reported in Ethiopia[25] and Tanzania[26]. The reason for the lower seroprevalence of syphilis observed in this study, compared to that in previous reports, is unclear, but could be ascribed to geographical differences in the prevalence of syphilis[1]. However, another explanation could be the lack of detection of syphilis latent infection, as we used mainly RPR and TPHA for syphilis detection and confirmation of syphilis infection. A recent study showed that T. pallidum particle agglutination assay and enzyme immunoassay are more sensitive than RPR and TPHA at detecting Treponema[27]. The prevalence of syphilis was not associated with age, place of blood collection or type of blood donor.

This study revealed a significant prevalence of HIV, HBsAg, HCV and syphilis co-infections among blood donors at Koudougou. The 1.39% prevalence of HBV-HCV co-infection found among these blood donors is higher than a previously reported prevalence of 0.031%[1]. In addition, the HIV-HBV co-infection rate of 0.38% observed among blood donors is higher than the 0.27% HIV-HBV co-infection rate reported by Tessema *et al.*[1]. The prevalence of HBV-syphilis (0.66%) and HIV-syphilis (0.04%) co-infections observed in this study also differed from the prevalence of HBV-syphilis (0.11%) and HIV-syphilis (0.30%) co-infections found in a recent study[1]. The prevalence of multiple infections with HBV, HCV and syphilis was 0.11%. We found that HBV-HCV was the major co-infection marker among blood donors from Koudougou in Burkina Faso. This difference could not be explained, but it is possible that it is due to geographical differences in the prevalences of HBV and HCV.

In conclusion, the prevalence of transfusion-transmitted infections is still high among blood donors at Koudougou. This could be explained by a selection of blood donors, including those with profiles of high-risk for HBV and HCV, such as donors from rural areas. Another explanation could be the poor retention of low-risk, non-remunerated

donors given that the prevalence of repeat blood donors in Koudougou was only 9.27%.

HBV and HCV are the most prevalent transfusion-transmissible diseases among blood donors in Burkina Faso. Screening and better selection of donors are necessary to improve blood safety in the regional blood transfusion centre of Koudougou.

Acknowledgements

We thank all the participants of this study, the CNTS staff and Miss Pearson for critically reading the manuscript.

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Received: 14 December 2010 - Revision accepted: 12 February 2011
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