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Prevalence of Blood-Borne Infectious Diseases in Blood Donors in Ghana

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Transfusion-transmissible infections among 808 blood donors in Ghana were investigated in 1999. Antibody seroprevalences of 3.8, 0.7, 8.4, and 13.5%, respectively, for human immunodeficiency virus, human T-cell lymphotrophic virus type 1, hepatitis C virus (HCV), and *Treponema pallidum* were obtained. The seroprevalence of HCV infection was confirmed to be 0.9% after supplementary testing, and the transfusion risk potential of these pathogens was demonstrated.

Although blood transfusion saves millions of lives worldwide each year, recipients of transfusions risk becoming infected with blood-borne pathogens. Each year, up to 4 million blood donations worldwide are not tested for human immunodeficiency virus (HIV) and few are tested for hepatitis B and C viruses (HBV and HCV, respectively). Virtually none are screened for human T-cell lymphotrophic virus type 1 (HTLV-1) or *Treponema pallidum*, the causative agent of syphilis (20). Several studies have previously indicated the high prevalence of HBV in Ghana (1, 3, 9, 15), and prescreening of blood donors for HBV surface antigen (HBsAg) is thus a routine practice. It is also a standard procedure to screen Ghanaian blood donors for HIV. HTLV-1, which causes leukemia (6, 19), was reported to be associated with HIV-1-seropositive individuals in Ghana (4–7). HCV is recognized as the primary cause worldwide of transfusion-associated non-A–non-B viral hepatitis (12) and is endemic in West Africa (13). However, information on HCV seroprevalence in Ghana is limited, and blood donors are not routinely screened for HCV (21). *T. pallidum*, the etiologic agent of syphilis (11), is prevalent in many African countries (16), but in Ghana, data on *T. pallidum* seroprevalence are scanty, with antibodies thought to occur as frequently as HBV antibodies (4). This study was therefore carried out to determine the current prevalence of HTLV-1, *T. pallidum*, and particularly HCV in Ghanaian blood donors in order to provide information for appropriate policies.

The National Blood Transfusion Service of Ghana currently selects blood donors on the basis of a health check questionnaire and prescreening for HBsAg; donated blood is then tested for the presence of HIV antibodies. We studied 3,131 individuals who presented at the National Blood Transfusion Service, Accra, Ghana, between June and August 1999 and who were routinely tested for HBsAg with a latex agglutination test kit (Biotech Laboratories Ltd., Suffolk, United Kingdom). Of these donors who were seronegative for HBsAg, 808 were randomly adopted as study subjects. Five milliliters of blood was collected from each of the 808 donors, labeled, and transported in coolers to the Virology Unit at the Noguchi Memorial Institute for Medical Research. Sera were then analyzed for antibodies to HIV, HTLV-1, HCV, and *T. pallidum* with SERODIA passive-particle agglutination assay kits (FUJIREBIO Inc., Tokyo, Japan). Qualitative testing protocols were applied according to the manufacturer's instructions, and serum dilutions were 1:16 for HTLV-1, 1:32 for HIV and HCV, and 1:80 for *T. pallidum.* Supplementary tests were deemed necessary to confirm HCV infection, as the samples were from healthy, asymptomatic individuals. Therefore, 68 samples shown by the SERODIA assay to be anti-HCV positive at a 1:32 serum dilution were retested at a 1:400 serum dilution, subjected to the HCV-SPOT assay (Genelabs Diagnostics Ltd., Singapore), and examined by an enzyme-linked immunoassay (IMUCHECK-HCV C50Ab; International Reagents Corporation, Kobe, Japan). Furthermore, a third-generation recombinant immunoblot assay (RIBA 3; Ortho Diagnostic Systems, Roissy, France) was applied. RIBA 3 detects antibodies to five structural and nonstructural HCV proteins (c100, c33c, c22p, NS5, and superoxide dismutase), enabling the determination of a full immunoblot profile (18). Test sera were considered positive when at least two of these antibodies were detected. Reverse transcription-PCR (RT-PCR) was also performed to confirm the presence of the HCV genome. HCV RNA in the sera was identified by a nested RT-PCR method using primers derived from the 5′ untranslated region as previously described (14).

The majority of the 808 blood donors lived in or around Accra, Ghana. Thirty (3.7%) of the donors were regular voluntary donors, and 778 (96.3%) were replacement donors who were family members of blood recipients. As shown in Table 1, the 21-to-25-year age group, which included 212 (26.2%) of the donors, was the largest, followed by the 26-to-30-year age

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TABLE 1. Age distribution and seroprevalence of anti-HIV, anti-TP, anti-HTLV-1, and anti-HCV in blood donors by the SERODIA assays

Age group (yr)	No. of donors (%)	No. (%) of donors seropositive for antibodies against[a]:				Total no. of infections	95% confidence interval[b]		
		HIV	TP	HTLV-1	HCV		Lower	Middle	Upper
16–20	61 (7.5)	2 (3.2)	12 (19.7)	1 (1.6)	6 (9.8)	21	1.6	2.6	3.9
21–25	212 (26.2)	9 (4.2)	19 (8.9)	3 (1.4)	23 (10.8)	54	5.1	6.7	8.6
26–30	186 (23.0)	3 (1.6)	27 (14.5)	0	16 (8.6)	46	4.2	5.7	7.5
31–35	145 (17.9)	7 (4.8)	14 (9.7)	1 (0.7)	14 (9.7)	36	3.1	4.5	6.1
36–40	102 (12.6)	9 (8.8)	9 (8.8)	1 (0.9)	3 (2.9)	22	1.7	2.7	4.1
41–45	59 (7.3)	0	12 (20.3)	0	5 (8.5)	17	1.2	2.1	3.3
46–50	32 (4.0)	1 (3.1)	13 (40.6)	0	0	14	1.0	1.7	2.9
51–55	9 (1.1)	0	2 (22.2)	0	1 (11.1)	3	0.1	0.4	1.1
56–60	2 (0.2)	0	1 (50)	0	0	1	0.0	0.1	0.7
Total	808	31 (3.8)	109 (3.5)	6 (0.7)	68 (8.4)	214	21.1 (single)	1.6 (double)	0.0 (triple)

[a] The 95% confidence intervals (lower, upper) for the percentages of the total numbers of donors that were seropositive for HIV, TP, HTLV-1, and HCV, respectively, were 2.6, 5.4; 11.2, 16.0; 0.3, 1.6; and 6.6, 10.5.
[b] Lower and upper 95% confidence intervals for the total lower, middle, and upper 95% intervals, respectively, were 24.0 and 27.1, 2.6 and 3.9, and 0.1 and 0.7. The number of infections present is indicated in parentheses.

group, with 186 donors (23.0%). The smallest group was that of the 56 to 60 year olds, with only 2 donors (0.2%). Overall, 46 donors (5.7%) were female and 762 donors (94.3%) were male. This trend of male bias is a regular feature at Ghanaian blood donation sites and is commonly observed during blood donation campaigns (J. Ansah, unpublished data).

The HBV seroprevalence rate for the study period was estimated to be 15.0% by routine prescreening, as 469 of 3,131 individuals were seropositive for HBsAg. Seroprevalence rates obtained by screening with SERODIA were as follows: for anti-*T. pallidum*, 13.5% (109 were seropositive); for anti-HCV, 8.4% (68 were seropositive); for anti-HIV, 3.8% (31 were seropositive); and for anti-HTLV-1, 0.7% (6 were seropositive). The presence of anti-HCV in the 68 sera initially found to be positive was confirmed as follows: 62 sera were confirmed by the HCV-SPOT assay, 7 sera were confirmed by RIBA 3, 5 sera were confirmed by the SERODIA assay (serum dilution, 1:400), and 3 sera were confirmed by IMUCHECK. Two sera were found to be HCV positive by RT-PCR. The reactivity profiles for samples that were found to be HCV positive by either RIBA 3, RT-PCR, or the SERODIA (dilution, 1:400) or IMUCHECK assay are shown in Table 2.

The 15% HBV seroprevalence level indicated by the HBsAg prescreening data for the 3-month duration of the investigation is similar to the previously reported HBsAg seroprevalence of 15.8% (15). The current transfusion transmission risk potential in Ghana for HTLV-1, HCV, and *T. pallidum* is illustrated by the data presented in Table 1. Total seroprevalence levels were highest in the age groups (21 to 36 years) corresponding to those described as the most sexually active (17). The highest seroprevalence observed was for anti-*T. pallidum* (13.5%). This corresponds with the results of previous studies of sexually transmitted diseases in Ghana, where *T. pallidum* and HBV were noted as the most frequently occurring pathogens (5). The seroprevalence of the anti-HTLV-1 antibody was found to be 0.7%, and the antibody was detected in male blood donors under 40 years of age. The low HTLV-1 seroprevalence obtained by our study confirms the earlier observation of low HTLV-1 antibody levels in Ghana (5). Previously, HTLV-1 antibodies were associated with HIV and HCV infections (7, 10), and 19% of the dual infections observed in our study involved HTLV-1 (one case with HIV, three cases with HCV). The 3.8% seroprevalence level obtained for HIV vindicates the screening of donated blood for HIV, and the national sero-

TABLE 2. Reactivity profiles for seven subjects positive for anti-HCV by either RIBA 3, PCR, the SERODIA assay, or the HCV-SPOT assay

Sample	RIBA 3						PCR	PA 1:400[b]	HCV-SPOT
	c100p	C33c	c22p	NS5	SOD	Conclusion[a]			
5716[c]	3+	4+	4+	4+	−	Positive	+	+	+
5856	±	1+	1+	−	−	Positive	−	−	+
7219	−	1+	1+	−	±	Positive	−	−	+
7895[c]	4+	4+	4+	−	−	Positive	+	+	+
7915	−	1+	2+	±	−	Positive	−	−	+
8131	3+	±	3+	±	±	Positive	−	−	+
8484	4+	1+	1+	±	−	Positive	−	−	+
6887	−	3+	−	±	±	Indeterminate	−	+	+
7876	−	3+	−	−	−	Indeterminate	−	+	+
8190[c]	−	+	−	±	±	Indeterminate	−	+	+

[a] RIBA 3 results were reported as positive when at least two antibodies were found and indeterminate when a single antibody was present (when antibodies were absent, samples were declared negative).
[b] PA 1:400 indicates serum dilution at 1:400 in the particle agglutination assay.
[c] This sample was also positive by the IMUCHECK-HCV enzyme-linked immunosorbent assay.

prevalence of HIV was estimated to be 3% in 2001 (17). HIV was involved in 59% of the multiple infections recorded and was a major dual infection with *T. pallidum.*

Use of the SERODIA or HCV-SPOT assay resulted in a high rate of anti-HCV false-positive results, which were resolved by supplementary assay (especially RIBA 3), and overall, HCV seroprevalence was 0.9%. Other reports on anti-HCV seroprevalence in Ghana, determined by screening assays, found seroprevalence rates of 5.4% in children (15), 2.8% in adults (21), and 5.2% in blood donors (2). Supplemental tests such as RIBA 3 are necessary to confirm the presence of HCV infection in asymptomatic Ghanaians. The presence of HCV in the blood is indicated by positive detection by RT-PCR (10), and our data showed two active cases of HCV infection among the blood donors.

In conclusion, this study illustrates the current transfusion-transmissible risk of *T. pallidum*, HTLV-1, and HCV in Ghana. It is recommended that routine blood screening prior to transfusion should include tests for anti-HCV and anti-*T. pallidum* antibodies. Developing appropriate methods for HCV diagnosis will require an evaluation of the cost-effectiveness of general screening and/or supplementary assays of donated blood. Periodic studies to investigate transfusion-transmissible infectious diseases are required to enable safety reviews of the blood supply.

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