SEROPREVALENCE AND RISK FACTORS FOR HUMAN IMMUNODEFICIENCY VIRUS, HEPATITIS B AND C VIRUSES INFECTIONS AMONG BLOOD DONORS AT THE BOLGATANGA REGIONAL HOSPITAL IN BOLGATANGA, GHANA

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ABSTRACT

This study sought to determine the seroprevalence of human immunodeficiency virus (HIV), hepatitis C virus (HCV), and hepatitis B surface antigen (HBsAg) among blood donors at Bolgatanga Regional Hospital, Ghana by blood group type, sex and age and also determining the association, if any, in the occurrence of the pathogens. The study population consisted of 4146 consecutive donors, 3920(94.5%) males and 226(5.5%) females, who donated blood between January 2004 through December 2007. Their age ranged from 17 to 58 years, and most (49.1%) were between 17-27 years. The seroprevalence of HIV, HBsAg and HCV among the subjects was found to be 4.05%, 12.64% and 3.57%, respectively. A higher prevalence of HBsAg was found among males 12.81% (502/3920) than in females 9.73% (22/226). There were no significant sex differences in the occurrence of HIV and HCV ($p > 0.05$ in each case). The age-specific prevalence of HBsAg decreased from 13.67% in donors aged 17-27 years through 8.68% in the 38-47 age group to 0.00% in the 58-67 year age group. Rh-negative blood group donors and Rh-positive group donors had similar prevalence rates of these viral infections. Whereas the highest seroprevalence of HBsAg was seen in blood group B (16.28%) and the lowest in blood group AB (0.00%), for HCV and HIV, the highest seroprevalence (5.88%) was seen in blood group A and the lowest in blood group AB (0.00%) among the Rh-negative group. The high seroprevalence of blood-borne infections in blood donated at Bolgatanga Regional Hospital calls for rigorous screening of blood donors, especially the younger population, for HBV, HCV and HIV and the establishment of strict guidelines for blood transfusions. Hepatitis positivity in the study population was statistically not associated with ABO blood groups.

INTRODUCTION

Blood-borne infectious diseases are still a risk among recipients of transfusions, although blood transfusion saves millions of lives worldwide each year. Worldwide, about 4 million blood donations are not tested for human immunodeficiency virus (HIV) and a small number are tested for hepatitis B and C viruses (UNAIDS, 1997). The most common complication of blood and blood products transfusion include hepatitis B virus (HBV), hepatitis C virus (HCV), hepatitis D virus (HDV), and hepatitis G virus (HGV) infections (Stevens *et al.*, 1990).

Between 210,000 and 560,000 adults and children in Ghana were living with HIV/AIDS at the end of 2003 (UNAIDS, 2004). From the HIV Sentinel Surveillance, the national prevalence rate for HIV had increased from 2.4 percent in 1994 to 3.6 percent in 2003 (Ghana Health Service (GHS), 2004). HIV prevalence rates are not uniform across the country; prevalence is high in densely populated areas, mining and border towns, and towns along main transportation routes. The main mode of transmission of the virus in Ghana is through heterosexual intercourse, which accounts for 75 to 80 percent of all HIV/AIDS infections (Ghana Health Service (GHS), 2004). Mother-to-child transmission accounts for about 15% and transmission through blood and blood products accounts for 5 percent of HIV/AIDS infection (Ghana AIDS Commission (GAC), 2001).

A number of studies have previously indicated a high prevalence of HBV in Ghana (Acheampong, 1991; Acquaye and Mingle, 1994; Martinson *et al.*, 1996) and HCV has also been documented as the main cause of worldwide transfusion-associated non-A– non-B viral hepatitis (Houghton *et al.*, 1991) and is endemic in West Africa (Jeannel *et al.*, 1998; Ampofo *et al.*, 2002). Pre-screening of blood donors for HBV, HCV and HIV is thus a standard procedure in the National Blood Transfusion Service of Ghana.

ABO blood groups are carbohydrate antigens that are expressed in many tissues. They play pivotal roles in modulating protein activities in infection and some types of cancer (Maubert *et al.*, 1998). A relationship between ABO/Rh in patients with HBsAg and HIV infection has been reported (Emeribe and Ejezie, 1992; Behal *et al.*, 2008). While blood group A is considered to be a risk factor for malarial severity, blood group O may confer some protection against disease severity (Fischer and Boone, 1998).

Limited information exists in the literature regarding the magnitude of blood-borne (i.e. hepatitis B and C viruses and HIV) pathogens and its association with blood group type. The presence of infection markers to these viruses in blood donors obviously presents a great risk to the recipient. In this study we investigate the prevalence of HIV seropositivity and hepatitis B and C viruses in blood donors.

MATERIALS AND METHODS

Study area

This retrospective study was conducted from January 2004 through December 2007 at the Bolgatanga Regional hospital, located in Bolgatanga, an area covering about 1,463 km^2 (564.9 sq mi) in the Upper East Region of Ghana. The Upper East Region of Ghana is located in the northeastern corner of the country and is bordered by Burkina Faso to the north and Togo to the east. The population of Bolgatanga in 2002 was estimated at 964,500. The catchment area's current population is projected at 1,004,244 (NDPC, 2009). The inhabitants of the district originate from the different tribes of Northern Ghana. The capital, Bolgatanga, is however cosmopolitan in character. Its inhabitants are not only of northern origin but there are also many of the inhabitants who are from other parts of Ghana and the West African sub-region. The climate is tropical with a rainy season from May to October and a long dry season with virtually no rainfall from November to April. Temperatures range between a maximum of 45°C in March/April and at least 12°C in December.

Subjects and sample collection

Four thousand, one hundred and forty-six blood donors (3,920 males and 226 females) were included in this study. This study was approved by the Research and Development Unit of the Bolgatanga Regional Hospital. Blood samples collected aseptically by venepuncture from the subjects, were analyzed for blood grouping, HBsAg, HCV and HIV. After centrifugation at 3000 rpm for ten minutes, the sera were collected into sterile containers and used for the HBsAg, HCV and HIV testing while the red blood cells were used for ABO typing.

ABO/Rhesus blood group typing
The ABO/Rhesus blood group system in the study population was determined using murine-derived monoclonal antibodies (Anti-A, B,O and Anti-D Blood Research & Fractionation Co., Tehran, Iran) by slide test applying standard procedure.

Testing for HIV
Abbott Determine™ HIV Test Cards (manufactured by Abbott Laboratories, Japan) were used for the detection of antibodies to HIV in the blood. It is an immunochromatographic method, which detects the presence of antibodies to HIV in human blood. It is an *in vitro* visually read qualitative test having more than 99.9% sensitivity and 99.75% specificity.

Testing for HBsAg
Abbott Determine™ HBsAg Test Cards (manufactured by Abbott Laboratories, Japan) were used to detect the HBsAg in the blood, which is also a fairly reliable test having more than 99.9% sensitivity and specificity. It is also an *in vitro* diagnostic test based on enzyme-linked immunochromatographic method and gives a qualitative visually read result.

Testing for HCV antibody
ACON® HCV Test Strip (manufactured by ACON Laboratories, USA) was used for the detection of antibodies to HCV in the blood. It is an immunochromatographic method, which detects the presence of antibodies to HCV in human blood. It is an *in vitro* visually read qualitative test having more than 99.0% sensitivity and 98.6% specificity.

Statistical analysis
Categorical data were analysed using the Fisher's exact test or χ^2 for trend. A p-value of < 0.05 was considered to be statistically significant. GraphPad Prism version 5.00 for windows was used for statistical analysis (GraphPad software, San Diego California USA, www.graphpad.com). A 95% Confidence Interval of the proportions of HIV, HBsAg and HCV prevalence were determined.

RESULTS
Overall and gender-specific prevalence
The overall prevalence of HBsAg among blood donors aged 17-58 years was 12.64% (n = 4146). The prevalence for HCV and HIV were 3.57% and 4.05% respectively. The prevalence of HBsAg in males was 12.81% (502/3920) compared to 9.73% (22/226) in females. The difference was found to be statistically significant (P = 0.0492) (Table 1). The prevalence of HCV and HIV in males were 3.62% (142/3920) and 4.08 (160/3920) respectively as compared to 2.65% (6/226) and 3.54% (8/226) respectively in females (Table 1). The difference was found not to be statistically significant from the chi square analysis

The highest prevalence of the ABO blood group was seen among the group O (44.9%; 1862/4146), followed by group B (29.9%; 1238/4146), group A (20.6%; 854/4146) and group AB (4.6%; 192/4146) (Figure 1A). This trend was the same among the Rhesus-negative group ABO blood group (Figure 1B) and among the Rhesus-positive ABO blood group (Figure 1C). Among the study population, the overall prevalence of Rhesus-negative blood group was 8.2% (338/4146) and that of the Rhesus-positive blood group was 91.8% (3808/4146) (Figure 1D).

Age-specific prevalence
From this study, HBsAg seroprevalence decreased with age, 13.67% in the 17-27 year age group through 8.68% in the 38-47 to 0.00% in the 58-67 year age group. The difference was found to be statistically significant ($P = 0.0002$) (Table 1). Though the prevalence of HCV increased from 3.15% to 5.17% in the 17-27 and 48-57 years age group respectively, this did not reach a significant level (P = 0.0549). HIV prevalence did not change significantly with age from this study (Table 1) using chi-square for trend.

The study showed highest prevalence of HBsAg at 13.88% (186/1340) in male donors aged 28-37 years and at 13.11% (16/122) in female donors aged 17-27 years. The maxi-

Table 1: Relationship between HBsAg, HCV and HIV seropositivity and selected variables among blood donors visiting Bolgatanga regional hospital, Ghana

RISK FACTORS	HBs Ag			HCV			HIV		
	n/N(%)	95% CI		n/N(%)	95% CI		n/N(%)	95% CI	
SEX									
Male	502/3920(12.81)	11.76-13.86		142/3920(3.62)	3.04-4.2		160/3920(4.08)	3.46-4.7	
Female	22/226(9.73)	5.87-13.59	P = 0.0492	6/226(2.65)	0.56-4.74	P = 0.5633	8/226(3.54)	1.13-5.95	P = 0.8195
AGE (yrs)									
17-27	278/2034(13.67)	12.18-15.16		64/2034(3.15)	2.39-3.91		76/2034(3.74)	2.92-4.56	
28-37	190/1412(13.46)	11.68-15.24		50/1412(3.54)	2.58-4.5		64/1412(4.53)	3.45-5.61	
38-47	50/576(8.68)	6.38-10.98		28/576(4.86)	3.1-6.62		20/576(3.47)	1.98-4.96	
48-57	6/116(5.17)	1.14-9.2		6/116(5.17)	1.14-9.2		8/116(6.90)	2.29-11.51	
58-67	0/9(0.00)		P = 0.0002	0/9(0.00)		P = 0.0549	0/9(0.00)		P = 0.4119
Rh GROUP									
Rh-Positive	474/3808(12.45)	11.4-13.5		136/3808(3.57)	2.98-4.16		158/3808(4.15)	3.52-4.78	
Rh-Negative	50/338(14.79)	11.01-18.57	P = 0.8943	12/338(3.55)	1.58-5.52	P = 0.8943	10/338(2.96)	1.15-4.77	P = 0.3576
BLOOD GROUP									
A	96/854(11.24)	9.12-13.36		28/854(3.28)	2.09-4.47		44/854(5.15)	3.67-6.63	
B	156/1238(12.60)	10.75-14.45		42/1238(3.39)	2.38-4.4		58/1238(4.68)	3.5-5.86	
O	258/1862(13.86)	12.29-15.43		68/1862(3.65)	2.8-4.5		60/1862(3.22)	2.42-4.02	
AB	14/192(7.29)	3.61-10.97	P = 0.4408	10/192(5.21)	2.07-8.35	P = 0.3117	6/192(3.13)	0.67-5.59	P = 0.0087

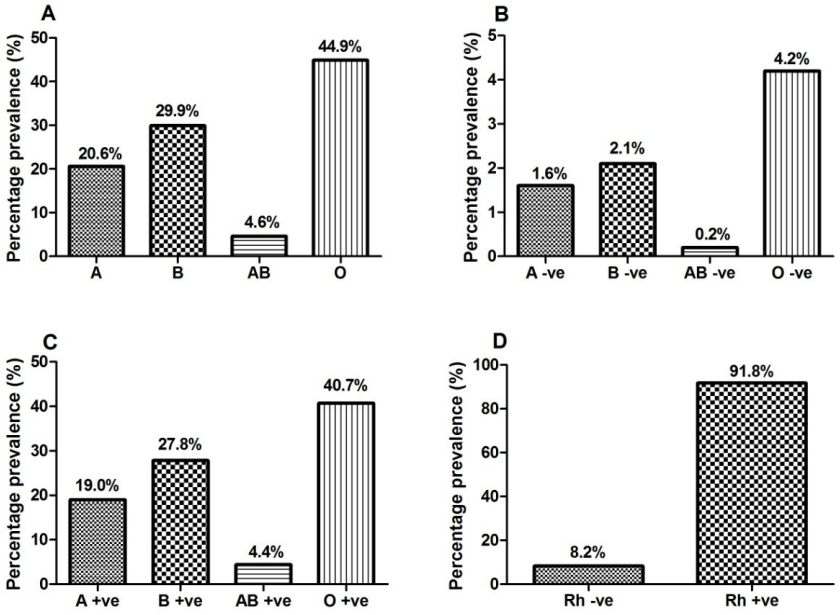

Fig. 1: Frequencies distribution of ABO and Rh blood group for the years 2004 – 2007 in Bolgatanga, Ghana

Table 2: HBsAg, HCV and HIV positivity in association with sex and age

Age (yrs)	Male			Female		
HBsAg	***n/N(%)***	***95% CI***	***P value***	***n/N(%)***	***95% CI***	***P value***
17-27	262/1912(13.70)	12.16-15.24		16/122(13.11)	7.12-19.10	
28-37	186/1340(13.88)	12.03-15.73		4/72(5.56)	0.27-10.85	
38-47	48/544(8.82)	6.44-11.20		2/32(6.25)	-2.14-14.64	0.1040
48-57	6/116(5.17)	1.14-9.20				
58-67	0/8(0.00)		0.0006			
HCV						
17-27	60/1912(3.14)	2.36-3.92		4/122(3.28)	0.12-6.44	
28-37	50/1340(3.73)	2.72-4.74		0/72(0.00)		
38-47	26/544(4.78)	2.99-6.57		2/32(6.25)	-2.14-14.64	0.8237
48-57	6/116(5.17)	1.14-9.20				
58-67	0/8(0.00)		0.0586			
HIV						
17-27	72/1912(3.77)	2.92-4.62		4/122(3.28)	0.12-6.44	
28-37	62/1340(4.63)	3.50-5.76		2/72(2.78)	-1.02-6.58	
38-47	18/544(3.31)	1.81-4.81		2/32(6.25)	-2.14-14.64	0.5549
48-57	8/116(6.90)	2.29-11.51				
58-67	0/8(0.00)		0.4705			

mum prevalence for HCV and HIV was 5.17% (6/116) and 6.90% (8/116) respectively among the male gender in 48-57 years age. For the three conditions the minimum prevalence was seen in the donors aged 58-67 years among the male. Whereas there was significant association (p = 0.0006) between age and male gender in relation to HBsAg, this association was marginal (p = 0.0586) for HCV. This study could not establish any significant association between age and female gender in relation to HBsAg, HCV and HIV positivity (Table 2).

Blood group-specific prevalence

There are no significant variation in the prevalence of HBsAg (P = 0.8943), HCV (P = 0.8943) and HIV (P = 0.3576). However, for HBsAg, this variation was marginally high among the Rhesus-negative group (14.79%) than those with Rhesus-positive group (12.45%). In the case of HIV, it was slightly high among the Rhesus-positive group (4.15%) than those with Rhesus-negative group (2.96%). HBsAg prevalence was higher in blood group O at 13.86% (258/1862) and lowest in blood group AB at 7.29% (14/192). The difference though was statistically not significant *(P* = 0.4408) (Table 1). However, the prevalence of HCV and HIV peaked at 5.12% and 5.15% for blood group AB and A respectively.

The present study showed highest seroprevalence of HBsAg in blood group B (16.28%) and lowest in blood group AB (0.00%) among the Rh-negative group. Among the Rh-positive group the highest seroprevalence was seen in blood group O (13.74%) and lowest in blood group AB (7.69%) (Table 3). For both HCV and HIV, the highest seroprevalence (5.88%) was seen in subjects with blood group A and the lowest in subject with blood group AB (0.00%) among Rh-negative group. Among the Rh-positive group, HCV was highest (5.49%) and lowest (3.05%) among subject with blood group AB and A respectively. HIV was however highest (5.09%) and lowest (3.30%) among subjects with blood groups A and AB respectively (Table 3).

Among male blood donors, HBsAg was found to be more prevalent in B-negative blood group at 17.07% (14/82) and lowest in AB-negative at 0.00% (0/10). Among the female donors, the highest seroprevalence of HBsAg was seen in O-negative blood group at 33.33% (4/12) (Table 4). For both HCV and HIV, the highest prevalence (5.88% each) was seen in A negative blood group and the lowest (0.00%) in the

Table 3: HBsAg, HCV and HIV prevalence according to blood group and Rh group

Blood group HBsAg	*n/N(%)*	*95% CI*	*n/N(%)*	*95% CI*
A	10/68(14.71)	6.29-23.13	86/786(10.94)	8.76-13.12
B	14/86(16.28)	8.48-24.08	142/1152(12.33)	10.43-14.23
AB	0/10(0.00)		14/182(7.69)	3.82-11.56
O	26/174(14.94)	9.64-20.24	232/1688(13.74)	12.10-15.38
HCV				
A	4/68(5.88)	0.29-11.47	24/786(3.05)	1.85-4.25
B	4/86(4.65)	0.20-9.10	38/1152(3.30)	2.27-4.33
AB	0/10(0.00)		10/182(5.49)	2.18-8.80
O	4/174(2.30)	0.07-4.53	64/1688(3.79)	2.88-4.70
HIV				
A	4/68(5.88)	0.29-11.47	40/786(5.09)	3.55-6.63
B	2/86(2.33)	-0.86-5.52	55/1152(4.77)	3.54-6.00
AB	0/10(0.00)		6/182(3.30)	0.70-5.90
O	4/174(2.30)	0.07-4.53	56/1688(3.32)	2.47-4.17

AB negative blood group among the male. Generally, the prevalence of these viral markers was slightly higher among the Rhesus negative blood group as compared to the Rhesus-positive blood group (Table 4).

Co-infection rate

From this study, 0.05% (2/4146) of the study population had all the three viral infections, 0.14% (6/4146) had hepatitis B and C co-infection, 0.24% (10/4146) had co-infection of hepatitis B and HIV, whilst none of the studied population had both hepatitis C and HIV co-infection. Out of the 168 individuals who were infected with HIV, 12 of them also had hepatitis B co-infection (7.1%), whereas 2 individuals had hepatitis C and B co-infection (1.2%).

DISCUSSION

In this study, the overall seroprevalence of hepatitis B surface antigen and antibodies against HCV and HIV were 12.64%, 3.57% and 4.05%, respectively. These figures compared well with those reported in Ghana and other parts of Africa (Sarkodie *et al.*, 2001; Ampofo *et al.*, 2002; Mbanya *et al.*, 2003; Oronsaye and Oronsaye, 2004; Uneke *et al.*, 2005).

Prevalence of HIV

The finding of 4.05% HIV seroprevalence from this study is relatively lower than that reported for blood donors in neighbouring countries i.e. about 10% in Cote d'Ivoire and Nigeria (De Cock and Brun-Vezinet, 1989; Umolu *et al.*, 2005). This finding was however similar to a previous report from the southern part of Ghana (Accra) where the prevalence of 3.8% was documented (Ampofo *et al.*, 2002). From this study, the fact that age group 48-57 had the highest seropositivity of HIV does not rule out

Table 4: HBsAg, HCV and HIV seroprevalence in association with blood group and sex

Blood group	*Male*		*Female*	
HBsAg	*n/N(%)*	*95% CI*	*n/N(%)*	*95% CI*
A-Negative	10/68(14.71)	6.29-23.13		
A-Positive	80/740(10.81)	8.57-13.05	6/46(13.04)	3.31-22.77
B-Negative	14/82(17.07)	8.93-25.21	0/4(0.00)	
B-Positive	138/1084(12.73)	10.75-14.71	4/68(5.88)	0.29-11.47
AB-negative	0/10(0.00)			
AB-Positive	12/174(6.90)	3.13-10.67	2/8(25.00)	-5.01-55.01
O-Negative	22/162(13.58)	8.30-18.86	4/12(33.33)	6.66-60.00
O-Positive	226/1600(14.12)	12.41-15.83	6/88(6.82)	1.55-12.09
HCV				
A-Negative	4/68(5.88)	0.29-11.47		
A-Positive	24/740(3.24)	1.96-4.52	0/46(0.00)	
B-Negative	4/82(4.88)	0.22-9.54	0/4(0.00)	
B-Positive	34/1084(3.14)	2.10-4.18	4/68(5.88)	0.29-11.47
AB-negative	0/10(0.00)			
AB-Positive	10/174(5.75)	2.29-9.21	0/8(0.00)	
O-Negative	4/162(2.47)	0.08-4.86	0/12(0.00)	
O-Positive	62/1600(3.88)	2.93-4.83	2/88(2.27)	-0.84-5.38
HIV				
A-Negative	4/68(5.88)	0.29-11.47		
A-Positive	36/740(4.86)	3.31-6.41	4/46(8.70)	0.56-16.84
B-Negative	2/82(2.44)	-0.90-5.78	0/4(0.00)	
B-Positive	56/1084(5.17)	3.85-6.49	0/68(0.00)	
AB-negative	0/10(0.00)			
AB-Positive	6/174(3.45)	0.74-6.16	0/8(0.00)	
O-Negative	4/162(2.47)	0.08-4.86	0/12(0.00)	
O-Positive	52/1600(3.25)	2.38-4.12	4/88(4.55)	0.20-8.90

more of the infection in the younger age group as most of the older people may have acquired the infection in their younger active sexual age. UNAIDS, (UNAIDS, 2000) has forecast that in Africa, AIDS, will become the cause of death of 50% of people now in their teens. The age of peak infection with HIV and HBsAg correlates well with the age of greatest sexual activity, supporting the role of sex in the transmission of HIV and hepatitis B virus. The variation in prevalence in the various age groups may also be attributed to the variation in duration and opportunity for risk exposure.

Prevalence of HBsAg

Regarding hepatitis B, the prevalence of 12.64% in this study means that this population of Ghanaians falls in the high endemic zone for hepatitis-B according to WHO classification (Low → 0.2-0.5%, Intermediate → 2-7%, High → 8-20%). The prevalence of hepatitis B virus in sub-Saharan Africa ranges between 3% and 22% in blood donors (Saha *et al.*, 1988; Ndumbe and Nyouma, 1990; Allain *et al.*, 1992; Sarkodie *et al.*, 2001). It varies from country to country and depends on a complex interplay of behavioral, environmental and host factors. Hepatitis B virus has been found to be lowest among individuals with high standards of living and highest among individuals with low socio economic status (Dienstag and Isselbacher, 1998). When the results of the present study were compared with those reported from similar blood donors, this study is in harmony with a report of prevalence rate from Kumasi-Ghana, 15% (Sarkodie *et al.*, 2001) and other countries like Cameroon, 11.72% (Zekeng and Kaptue, 1990) and Ethiopia, 14.4% (Rahlenbeck *et al.*, 1997). This study however, showed relatively lower prevalence of the hepatitis-B surface antigen when compared to Mauritania, 20.3% (Lo *et al.*, 1999) and relatively higher to countries like, Thailand 4.51% (Luksamijarulkul *et al.*, 2002), Brazil 1.9% (Martelli *et al.*, 1991) and a US community, 0.15% (Kim *et al.*, 2004).

Prevalence of HCV

The hepatitis C sero-prevalence of 3.57% in blood donors in this study is similar to the report from Accra, Ghana, where 2.8% prevalence was found among pregnant women and blood donors (Wansbrough-Jones *et al.*, 1998). The finding is much higher than that reported from developed countries, 0.42%-0.9% (Stevens *et al.*, 1990). Prevalence rates reported from some African countries also differ from place to place; a high prevalence of 6.0% was found in blood donors in a Nigerian study (Egah *et al.*, 2004) while 15.8% prevalence was reported among Egyptian blood donors (Nabulsi *et al.*, 1997). Cultural differences or cross reactivity with region-specific antigens might explain this observed variation between developed and developing countries (Dawson *et al.*, 1991; Sulaiman *et al.*, 1995). These include socio-cultural practices involving the use of sharp instruments contaminated by blood and body fluids for procedures such as scarifications, tattooing, circumcision and so on which are common practices in the study area.

The finding of high HCV prevalence in an area with a population of about 1 million suggests that the new urban lifestyle of a developing nation may expose city dwellers to risk factors associated with HCV infection. Further studies are needed to explain the underlying reason for the higher prevalence.

Allain *et al.,* (1992) have reported the need for confirmatory testing of samples found to be positive for anti-HCV by EIA. Unfortunately, as part of the limitation of this study, we did not perform confirmatory recombinant immunoblot testing, a technique commonly used for this purpose. The high prevalence of HCV could possibly be due to the technique used for diagnosis. However, in Ghana this is the current technique used for routine diagnosis of HCV.

Sex-specific prevalence

Overall, 226 donors (5.5%) were females and 3920 donors (94.5%) were males. The gender proportions observed in this study are in agreement with the report of Ampofo *et al.,* (2002) where the percentage of female and male do-

nors were 5.7% and 94.3% respectively. Ghanaian blood donation is often characterized by male bias. With respect to gender related-prevalence, this study showed higher prevalence of hepatitis and HIV in males than females, though they did not reach a significant level except for HBsAg. This finding is in agreement with other studies, which demonstrated a higher prevalence of HBsAg among the male population (Jayaprakash *et al.*, 1983; Asakura *et al.*, 1991; Behal *et al.*, 2008). The high prevalence of HBsAg infection in male blood donors was responsible for the overall high prevalence in blood donors, which were pre-dominated by male donors. Another important contributing factor that could have been responsible for the higher prevalence among the male population of the present study is that plasma disappearance rate for HBsAg in males is lower than females (Thursz, 1997; Behal *et al.*, 2008).

Age-specific prevalence

The present study has revealed HBV seropositivity in relation to age. The positivity for HBsAg decreased with age. Studies have shown that the likelihood of chronicity after acute HBsAg infection varies as a function of age in both immunocompetent and immunocompromised hosts (Dienstag and Isselbacher, 1998). In this study higher HBsAg seroprevalence was observed among the 17-37 years age category (i.e. 17-27 and 28-37 year groups) of the blood donors. This could be associated with sexual activity and intravenous drug use reported to be highest among Ghanaians in their third decade of life (Ghana Health Service (GHS), 2004). In the present study, individuals aged 58 years and above showed no seropositivity in both sexes. Self-selection due to persistent HBV infection may partly account for such tendencies (Asakura *et al.*, 1991).

Blood group-specific prevalence

Regarding blood group distribution in caucasian populations, blood group O positive is said to be the commonest, contributing 46%, followed by A positive, B positive and AB positive with 41%, 9% and 4% respectively. This current study of Ghanaian blood donors shows dissimilar distribution of blood group with O + 41%, A + 19%, B + 28% and AB + 4%. Also, the Rhesus group in the study population was found to be almost exclusively positive with 92% while, research done in caucasian population has shown it to be 85%. Our result is however in agreement with that of studies from Nigeria (Omotade *et al.*, 1999; Bakare *et al.*, 2006). This finding is also in agreement with the assertion that the frequency of rhesus negative is often low in parts of the world where malaria is endemic (Falusi *et al.*, 2000).

There was association between blood group distribution and HIV, but no such association was found for hepatitis B and C. This is in accordance with other studies (Emeribe and Ejezie, 1992; Behal *et al.*, 2008). This study further agrees with earlier studies that reported no prevalence of HBsAg in AB blood group donors. Higher prevalence of HBsAg in blood group O could be because of the fact that blood group O is the most prevalent among the studied population (44.9%). The study also demonstrated no significant difference in the hepatitis positivity among donors with Rh-negative group and Rh-positive group.

Co-infection rate

Among the HIV-infected blood donors, HBV co-infection was greater (7.1%) than HCV co-infection (0.0%), and HBV/HCV co-infection (1.2%). This is similar to the findings of other studies (Treitinger *et al.*, 2004; Uneke *et al.*, 2005). It has been shown that HIV infection is associated with about a three-fold increase in the development of persistent hepatitis B surface antiginemia (Fauci and Lane, 1998). The reported effect of increased HBV infection among HIV positive individuals observed in this study could be attributed to the development of persistent hepatitis B surface antiginemia (Fauci and Lane, 1998).

CONCLUSION

This study has provided additional information on the burden of hepatitis B and C virus and

HIV infection in Bolgatanga, Ghana. Both hepatitis and HIV were identified as significant threats and therefore continued surveillance is required by the Ghanaian blood bank management. This report also presents the distribution of the ABO and Rh blood group system of a Ghanaian population at Bolgatanga.

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