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ORIGINAL ARTICLE

Safety of Family Replacement Donors vs. Voluntary Non-Remunerated Donors in Komfo Anokye Teaching Hospital, Ghana: A Comparative Study

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Blood safety remains a challenge to many countries in sub-Saharan Africa including Ghana due to poorly planned blood donation exercises in the various communities. Blood and its products usually come from two main sources; voluntary non-remunerated donors (VNRD) and family replacement donors (FRD). In Ghana, and in many developing countries, FRDs seem to be the major source of blood supply whilst in developed countries VNRDs are the major source. This study determined and compared the prevalence of four transfusion transmissible infections (TTIs); HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), and *Treponema palladium* (TP) among FRDs and VNRDs at the Komfo Anokye Teaching Hospital to compare the safety of blood from these two groups. This cross-sectional study was undertaken at the transfusion medicine unit (TMU) of the Komfo Anokye Teaching Hospital between March and May 2014. A total of 400 blood donors (200 FRDs and 200 VNRDs) were enrolled in this study after obtaining written informed consent. Blood samples from each of the donors were then tested for HIV, hepatitis B and C, and syphilis using rapid test kits. ABO and Rhesus blood groups were also determined for all the samples. Prevalence of TTIs was higher among FRDs (23.5%) than in VNRDs (3.5%) with males (47) been more infected than females (7). Age group 21- 30 years was the most infected, followed by age groups 31- 40 years, 11- 20 years, 41- 50 years and 51- 60 years respectively. FRDs among the younger age group, 17- 30 years, were also more infected than their VNRD counterparts. Repeat blood donors among the VNRD group, were found to be safer than their first-time counterparts. Overall, TTIs were significantly higher in the FRD group than in the VNRD group. The prevalence rates of all the infections tested were higher in the FRD group compared to the VNRD group. FRDs were the higher risk population for TTIs in comparison to VNRDs. VNRDs should therefore be encouraged to donate blood regularly.

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INTRODUCTION

Blood transfusion has been known to be a major source of transmission of infections such as hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human immunodeficiency virus (HIV) (Hussain, 2011). Unsafe blood transfusion practices have far-reaching consequences not only for the recipient, but the community and wider society due to its resultant morbidity and mortality. The infected recipients become a new pool for the infection and can thus transmit the disease during the asymptomatic period (Buseri *et al.*, 2009a; Abdallah and Ali, 2012). The World Health Organisation (WHO) defines blood safety, broadly, as the adequate and timely provision of safe blood and blood products to all those in need of transfusion; the product must be of the right efficacy and adequate quantity to correct the homeostatic defect in the normal physiology of the blood for the patient, and must be free of

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all infections transmissible by transfusion (Tapko *et al.*, 2009). To achieve safe blood, WHO advocates for a 100% worldwide VNRD by 2020 as they are known to be a safer source of blood compared to other blood donors such FRD (WHO, 2010).

Blood recipients in developing countries such as Ghana are at an increased risk of TTIs due in large part, to the high prevalence rates of HIV, hepatitis B and C viral infections. Repeat voluntary donors are essential as they have been known to be a reliable supply of safe blood in many developing countries including Ghana (Tapko *et al.*, 2009). The aim of this study was therefore to determine the degree of safety of blood from VNRDs on one hand, and FRDs on the other, with the view to providing a basis for policy change in the health delivery system of the country.

MATERIALS AND DESIGN

Study design and blood sample collection

A total of 400 blood donors comprising 200 family replacement donors (FRDs) and 200 voluntary non-remunerated donors (VNRDs) who met the blood donation criteria such as age, body weight and haemoglobin concentration were enrolled for the study. Ethical approval was obtained from the Research Development Unit (RDU) of the Komfo Anokye Teaching Hospital (KATH), and the local Committee on Human Research Publication and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST), School of Medical Sciences. In addition, a written informed consent was obtained from all participants after the objectives of the study had been thoroughly explained to them.

Under completely aseptic conditions, 3 ml of venous blood was drawn into EDTA tubes, plasma was collected after centrifugation in sterile plain tubes and were analyzed for anti-HIV I and II antibodies, HBV surface antigen (HBsAg), anti-HCV antibodies, and antibodies to Treponema pallidum, the causative organism for syphillis. The red blood cells were used for ABO and Rhesus typing using the tube technique. All procedures were performed as per the manufacturers' instructions.

HIV, HBsAg, HCV and Syphilis testing

Abbott Determine® HIV rapid test kits (Abbott Laboratories, Japan), were used for the detection of antibodies to HIV 1 & 2 whilst Abon® rapid test kits (Abon Biopharm, China), were used to detect the presence of HBsAg and antibodies to hepatitis C virus. Fortress® rapid test kits (Fortress Diagnostics Limited, United Kingdom), were used for the detection of antibodies to T. pallidum. In all cases, the manufacturer's protocols were strictly adhered to.

ABO/Rhesus blood group typing

The ABO/Rhesus blood groups of the study participants were determined using murine-derived monoclonal antibodies (Anti-A, B, O and Anti-D, Blood Research and Fractionation Co., Tehran, Iran) by tube technique. The red blood cells were washed 3 times using physiological saline after which a 2 - 5% suspension was prepared and used for grouping. A drop of the monoclonal antisera, anti- A, B and anti- D were dispensed in 3 sterile plain tubes and a drop of the washed red cells added to each of the tubes. The mixtures in the tubes were then subjected to a quick spin for 30 seconds and then checked for agglutination using the naked eye and then confirmed under the microscope.

Statistical analysis

Statistical analysis was carried out using Microsoft Excel 2010 and GraphPad Prism version 5.0 (GraphPad Software, San Diego, California, USA) for windows. Qualitative data are described as numbers and percentages. Comparisons between data sets were done using the Fischer's exact test at 95% confidence interval. Results were considered statistically significant when the two-tailed p-value was < 0.05.

RESULTS

Comparison of demographic features of FRDs and VNRDs

Majority (50.0%) of the blood donors involved in the study were in the age group 21 – 30 years whilst

the least number of donors came from the 51 – 60 years age group. Male blood donors were in the majority for both VNRDs (89.5%) and FRDs (88.5%). Whereas majority of the FRDs (73.0%) were first time donors, the reverse was the case for the VNRD group with majority of them (83.5%) been repeat donors (Table 1).

Table 1: Comparison of demographic Features between FRDs and VNRDs

Risk Factors	Total (n=400)	FRDs (n=200)	VNRDs (n=200)
Age (yrs)			
17 - 20	28(7.0%)	18(9.0%)	10(5.0%)
21 - 30	202(50.5%)	86 (43.0%)	116(58.0%)
31 - 40	115(28.85%)	68(34.0%)	47(23.5%)
41 - 50	47(11.75%)	26(13.0%)	21(10.5%)
51 - 60	8(2.0%)	2(1.0%)	6(3.0%)
Gender			
Male	356(89.0%)	177(88.5%)	179(89.5%)
Female	44(11.0%)	23(11.5%)	21(10.5%)
Donor type			
First time	179(44.7%)	146(73.0%)	33(16.5%)
Repeat	221(55.3%)	54(27.0%)	167(83.5%)

Values are presented as frequency (% percentage) and comparison between variables was done with Fischer's exact test. Majority of the FRDs were first time donors whilst the reverse was the case for the VNRDs, with majority of the donors in both groups been males.

Comparison of the prevalence of transfusion-transmissible infections between FRDs and VNRDs

The overall prevalence of TTIs was significantly higher ($p<0.0001$) in the FRD group (23.5%) than in the VNRDs (3.5%). In all instances, the prevalence rates of the infections tested (HIV, HBV, HCV, *T. pallidum*) were higher in the FRDs than in the VNRDs. The differences however reached statistically significant levels only in the cases of HBV infection ($p=0.0013$) and syphilis ($p=0.0009$) (Table 2) .

Prevalence of transfusion-transmissible infections in different age groups

HBV, HCV, HIV and T. *pallidum* infections were present among participants in the age groups 11-20 years (14.3%), 21-30 (2.0%), 41-50 years (6.4%) and 31-40 years respectively, but not in the 51-60 years age group. This notwithstanding, age was not significantly associated with TTIs ($p>0.05$) **(**Table 3).

Table 2: Comparison of the prevalence of transfusion-transmissible infections between FRDs and VNRDs

Pathological markers	Total Reactivity	FRDs (n=200)	VNRDs (n=200)	p- value
HIV	7	6(3.0%)	1(0.5%)	0.122
HBV	27	22(11.0%)	5(2.5%)	0.0013
HCV	5	5(2.5%)	0(0%)	0.0611
T. pallidum	15	14(7.0%)	1(0.5%)	0.0009
Total	54	47(23.5%)	7(3.5%)	< 0.0001

Values are presented as frequency (% percentage) and comparison between variables was done with Fisher's exact test. Infection rates were higher in the FRDs than in the VNRDs

Table 3: Prevalence of transfusion-transmissible infections among the various age groups

Markers	11 – 20 (n= 28)	21- 30 (n= 202)	31- 40 (n= 115)	41- 50 (n= 47)	51- 60 (n= 8)	P-value
HIV	0(0%)	3(1.5%)	1(0.9%)	3(6.4%)	0 (0%)	0.1566
HBV	4(14.3%)	16(7.9%)	7(6.1%)	0(0%)	0 (0%)	0.183
HCV	0(0%)	4(2.0%)	1(0.9%)	0(0%)	0 (0%)	0.7331
T. pallidum	1(3.6%)	7(3.5%)	6(5.2%)	1(2.1%)	0 (0%)	0.8622

Values are presented as frequency (% percentage) and comparison between variables was done with Fisher's exact test. There was no significant association between age and TTIs.

Comparison of the prevalence of transfusion-transmissible infections between FRDs and VNRDs among the young age group (<30 years)

Among the younger age group (<30 years), TTIs were more prevalent in the FRD group than in the VNRD group, with the differences reaching statistically significant levels except in the case of HIV infection. (HBV; $p = 0.0172$, HCV; $p = 0.0421$, *T. palladium*; $p = 0.0019$, HIV; $p = 0.5891$) (Table 4).

Table 4: Comparison of the prevalence of transfusion-transmissible infections between FRDs and VNRDs among the younger age group (< 30 years)

Pathological markers	FRDs (n=96)	VNRDs (n=119)	P-value
HIV	2 (2.1%)	1 (0.8%)	0.5891
HBV	14 (14.6%)	5 (4.2%)	0.0172
HCV	4 (4.2%)	0 (0.0%)	0.0421
T. pallidum	8 (8.3%)	0 (0.0%)	0.0019

Values are presented as frequency (% percentage) and comparison between variables was done with Fisher's exact test. Infection prevalence was significantly higher in the FRD group than in the VNRD group except for HIV infection where the difference between the two groups did not reach statistically significant levels

Prevalence of transfusion-transmissible infections stratified by gender

HBV and HCV infections were more prevalent among the male donors whereas HIV and syphilis infections were higher among females (Table 5). Except for HIV ($p = 0.0318$), the differences were insignificant, statistically.

Table 5: Prevalence of transfusion-transmissible infections according to gender

Pathological marker	Males (n = 356)	Females (n = 44)	P value
HIV	4(1.1%)	3(6.8%)	0.0318
HBV	25(7.0)%	2(4.5%)	0.7540
HCV	5(1.4%)	0(0.0%)	1.0000
T. pallidium	13(3.7%)	2(4.5%)	0.6750

Values are presented as frequency (% percentage) and comparison between variables was done with Fischer's exact test.

Comparison of the prevalence of transfusion-transmissible infections between First-time donors and Repeat donors under VNRDs

First time donors reported the highest prevalence of infection (3.0% for HIV and 15.2% for HBV infection) with 0.6% T. pallidum infection occurring in repeat donors. HIV, HBV and HCV infections did not occur in repeat donors. Also, HCV and syphilis infections were not associated with first time donors (Table 6).

Table 6: Comparison of the prevalence of transfusion-transmissible infections between First-time donors and Repeat Voluntary Non-Remunerated Donors

Pathological markers	First-time donors (n=33)	Repeat donors (n=167)	P-value
HIV	1 (3.0%)	0 (0.0%)	0.1692
HBV	5 (15.2%)	0 (0.0%)	0.0002
HCV	0 (0.0%)	0 (0.0%)	-
T. pallidum	0 (0.0%)	1 (0.6%)	1.000

Values are presented as frequency (% percentage) and comparison between variables was done with Fisher's exact test. Infection rates were higher in first time donors in comparison to repeat donors.

DISCUSSIONS

Transfusion-transmissible infections are a major public health burden affecting millions of lives worldwide. The chances of receiving a safe blood transfusion vary enormously from one country to another and depend largely on the presence of a safe blood transfusion programme. This study determined and compared the prevalence of TTIs among FRDs and VNRDs in KATH in order to compare the safety of blood donated by these two groups.

The overall prevalence of TTIs was higher in the FRD group (23.5%) than in the VNRD group (3.5%) in agreement with an earlier study by (Fessehaye *et al.*, 2011), as was the disease specific prevalence rates for all the infections tested, in agreement with those reported from previous studies (Durro and Qyra, 2009). Having previously do-

nated blood, the VNRDs, particularly the repeat donors, would have been educated on practices that predispose them to these infections, and are thus less likely to have a higher prevalence of TTIs in comparison to the FRDs. The generally higher deferral rate of females in comparison to males as previously reported by (Ray *et al.*, 2005), was collaborated in our study in which we found many more males than females amongst the donors. This disparity however did not seem to have an effect on the pattern of infection of the study participants with respect to gender. The higher prevalence of HBV infection in the males could be due to the generally slower disappearance rates of HBsAg in males in comparison to females (Behal *et al.*, 2008). A more recent study (Bani and Giussani, 2010), however had many more women than men participating in the donations and may be due to the increased awareness in recent times about the essence of blood donation and the demystification of the belief that women by virtue of their monthly loss of blood are generally not fit to donate blood.

The generally lower prevalence rates of infections in our study in comparison to previous studies ((Barreto *et al.*, 2009) may be attributable not only to the larger sample size they used but also to the sensitivity of the test methods employed. Whereas RDTs were used in the present study, Barreto et al employed the more sensitive ELISA in their study. These notwithstanding, the fact that infection rates are higher in FRDs in comparison to VNRDs were not lost on both studies.

Lifestyle and socioeconomic variations such as prostitution, peddling of drugs and homosexuality among the young people generally, (Buseri *et al.*, 2009b), could explain the higher prevalence of the TTIs in the younger age group whiles the low representation of donors in the 50 to 60 year bracket in the blood donation campaign may account for the near absence of infections in this group (Allain, 2011).

Among the VNRDs, repeat donors were safer to donate blood than first time donors and were less likely to transmit infections than the first time donors, in agreement with (Adouani *et al.*, 2013), who indicated that blood from first-time donors were not always safe in blood donation programmes. Additionally, repeat blood donors who may get infected during the course of their lives have a high tendency of discontinuing their periodic blood donations knowing the consequences they may pose.

CONCLUSION

We conclude that VNRDs are a much safer and a more reliable source of blood for transfusion than FRDs. Younger males are more likely to be associated with TTIs than their female counterparts.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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