

# Transfusion Transmissible Infections among Voluntary Blood Donors in a Tertiary Care Hospital, Kerala - A Cross Sectional Study

Raji T.K.<sup>1</sup>, Deepa Narayanan<sup>2</sup>

<sup>1</sup>Department of Microbiology, Government T.D. Medical College, Alappuzha, Kerala, India.

<sup>2</sup>Department of Transfusion Medicine, Government Medical College, Kozhikode, Kerala, India.

## ABSTRACT

### BACKGROUND

Blood transfusion is a common life-saving medical procedure, but it may cause acute and delayed complications. A transfusion transmissible infection (TTI) is any infection that is transmissible from person-to-person through parenteral administration of blood or blood products i.e. packed red blood cells (RBC), platelets, plasma and other blood products. This study was undertaken to assess the prevalence of transfusion transmissible infections among blood donors in blood bank connected to a tertiary care hospital in Kerala and evaluate the safety of the blood donations.

### METHODS

Samples of 13,262 donors from January to June 2018 were taken. All the donors who were accepted for donation as per criteria by national acquired immunodeficiency syndrome (AIDS) control society were included in the study. Consent was obtained from blood donors to conduct testing for transfusion transmitted diseases. Donors were screened by 4th generation enzyme linked immuno sorbent assay (ELISA) test kits for HIV-1/2, 3rd generation ELISA test kits for HBsAg and hepatitis C virus (HCV), rapid immunochromatographic test for malaria and rapid plasma reagin (RPR) test for syphilis. Tests were performed as per manufacturer instructions. All the reactive samples were discarded as per the guidelines.

### RESULTS

Among 13,262 donors, 13,014 (98.12 %) were males and 248 (1.8%) were females within the age group of 18 - 60 years. Out of these, 7 (0.052%) donors were HBsAg positive and 3 (0.02%) were HIV positive. RPR reactivity was seen in 2 donors (0.01%) only. None of the blood donors tested showed positivity for HCV or malarial parasite. In this study, prevalence of hepatitis B was highest (0.052) followed by HIV (0.02%) and syphilis (0.02%).

### CONCLUSIONS

Hepatitis B virus (HBV) is the most common transfusion transmissible infection among apparently healthy donors, followed by HIV and syphilis. TTI's can be eliminated or reduced by implementing an integrated strategy for blood safety, like effective selection of blood donors, avoiding unnecessary transfusions, and early detection of TTIs.

### KEYWORDS

Transfusion-Transmitted Infections, HIV, HBV, HCV

*Corresponding Author:*

*Dr. Deepa Narayanan,  
Associate Professor,  
Department of Transfusion Medicine,  
Government Medical College,  
Kozhikode, Kerala.  
E-mail: drdeepa2@gmail.com*

*DOI: 10.18410/jebmh/2021/478*

*How to Cite This Article:*

*Raji TK, Narayanan D. Transfusion transmissible infections among voluntary blood donors in a tertiary care hospital, Kerala - a cross sectional study. J Evid Based Med Healthc 2021;8(29):2589-2594. DOI: 10.18410/jebmh/2021/478*

*Submission 11-01-2021,*

*Peer Review 21-01-2021,*

*Acceptance 03-06-2021,*

*Published 19-07-2021.*

*Copyright © 2021 Raji T.K. et al. This is an open access article distributed under Creative Commons Attribution License [Attribution 4.0 International (CC BY 4.0)]*

## BACKGROUND

Blood transfusion is a lifesaving procedure. Human to human blood transfusion was started in the late eighteenth century. Ever since it has been noticed that there are complications associated with it. Blood transfusion carries risk of transmitting a disease to the recipient if the donated blood unit is not properly screened. Blood banks have the responsibility of screening the blood for transfusion transmitted diseases so that the recipient is protected from the risk. A transfusion transmissible infection is any infection that is transmissible from person to person through parenteral administration of blood or its blood products. Most transmissions result in transient and self-limited illnesses without major sequelae. Meticulous pre-transfusion testing and screening for transfusion transmissible infections are mandatory to prevent complications. Transfusion transmitted infection was first noted in the late 1940s. With every unit of blood, there is a 1 % chance of transfusion associated problem including transfusion transmitted diseases.<sup>1</sup> Infectious agents like human immunodeficiency virus, hepatitis B virus, hepatitis C virus, syphilis and malaria, causing greatest threats to the recipient and leads to a serious public health problem. Accurate estimates of risk of TTIs are essential for monitoring the safety of blood supply.

Safe blood is a right of every patient. Blood safety is assured at multiple levels by avoiding donors with high risk behaviour, avoiding donors with acute infections like fever, history of jaundice within one year and by proper screening of blood. As per guidelines of National AIDS Control organization (NACO) of India, it is mandatory to test each and every blood unit for HIV, HCV, HBs Ag, syphilis and malaria.<sup>2,3</sup>

Countries around the world celebrate World Blood Donors Day on June 14 every year to mark the anniversary of Karl Landsteiner. This raises awareness about the need for safe voluntary blood donation, to thank the donors who donate blood, and to support the national blood donor programmes.

Prevalence of transfusion transmitted diseases among blood donors has been studied in India before.<sup>4,5,6,7,8,9,10</sup> Study by T Chandra et al. in Lucknow has shown more prevalence of transfusion transmitted disease among replacement donors than voluntary donors. In this study HBsAg was more prevalent among blood donors.<sup>3</sup> In a study at Mumbai among blood donors by Sushma et al. showed a prevalence of HIV, HBsAg, HCV, and syphilis as 0.26 % 1.30 %, 0.25 %, and 0.28 % respectively. This study also showed 0.007 % of donors with multiple infection and a decreasing trend in the prevalence of transfusion transmitted diseases over a period of 5 years.<sup>4</sup> In a study from Delhi showed the prevalence rate of HCV, HIV and HBsAg as 0.66 %, 0.56 %, and 2.23 % respectively. This study was conducted from 2002 to 2005, also shows decreasing trend in the prevalence from 2002 to 2005.<sup>6</sup> In a study by RN Makroo et al. in New Delhi from 1999 to 2009 showed prevalence of HIV among blood donors as 0.249 %.<sup>11</sup> In a study conducted by Rawat A et al. in Delhi from January 2008 to December 2014 for a period of 7 years, the seroprevalence of HIV, HBV, HCV,

syphilis and malaria were 0.32, 1.61, 0.73, 1.62 and 0.06 per cent, respectively.<sup>10</sup>

In a study conducted by Fernandes et al. at Mangalore, showed the prevalence of TTI in total donors as 0.6 % with prevalence of hepatitis B (0.34 %) syphilis (0.11 %), HIV & HCV (0.06 %) and malaria (0.01 %). They noted higher prevalence of TTI among replacement donors and males.<sup>12</sup>

Magnitude of transfusion transmissible infection varies from country to country. Risk of transfusion transmitted diseases is more in developing countries like India than developed countries because of lack of awareness among people, lack of funds for widespread implementation of screening techniques like chemiluminescence, fourth generation ELISA and nucleic acid technology. Lack of properly trained staff in many rural areas may also result in reduced implementation of screening methods like ELISA, chemiluminescence and nucleic acid technology. Paid and professional donors may transmit transfusion transmitted diseases but now blood is rarely collected from such donors. Risk of transfusion transmitted diseases is more in patients receiving multiple blood transfusions. Safety measures like donor selection which limits the window period, skin disinfection and use of diversion bags in the blood banks or reducing the bacterial contamination during blood donation; the screening of blood donations for HBV, HCV, HIV, malarial parasites and *Treponema pallidum*, before transfusion will reduce rate of transfusion transmitted infections.

## Objectives

To find out the trend, prevalence of transfusion transmissible infections among blood donors in blood bank connected to a tertiary care hospital in Kerala, the most affected age group and gender in blood donors and to evaluate the safety of the blood donations.

## METHODS

This study was a hospital based cross sectional study conducted at Transfusion Medicine Department, Government Medical College, Kozhikode, Kerala, India for a period of 6 months from January 2018 to June 2018. Permission from head of the institution and clearance from institutional ethics committee were obtained.

## Inclusion Criteria

Physically healthy people aged between 18 - 60 years with weight more than 45 kg who were accepted for blood donation after physical examination by doctors were included in the study.

## Exclusion Criteria

Donor aged below 18 years, body weight less than 45 kg, anaemic, or were apparently unhealthy and malnourished, were excluded. Donors with pre-existing illness like cardiac diseases, malignancy, epilepsy, renal diseases, bleeding tendencies, those have donated blood within the past three

months, history of recent jaundice, those involved in high-risk behaviours and all those who were not fit to donate blood after examination by doctors were also excluded from this study.

All the donors were requested to fill the questionnaire prepared as per NACO guidelines for donor eligibility. Data on donor's age, sex, blood group, occupation, number of previous donations and contact number were obtained. Weight, pulse rate, blood pressure of donors was recorded. Consent was taken from donors before blood donation. 13262 donors who were fit to donate were included in the study. Majority of the donors were aged between 18 and 60 years. 98.1 % of donors were males and 1.9 % were females, a finding similar to other studies 5, Blood was collected under aseptic precautions from donors after obtaining written consent. Blood samples were collected in test tubes for screening. Samples were screened for HIV antibodies 1/2 by Qualisa HIV 4.0 (Qualpro Diagnostics), a 4th generation ELISA kit, HCV by Erba Lisa HCV gen 3 (v2) from Transasia Biomedicals LTD, and HBsAg surface antigen by Qualisa HBsAg (Qualpro diagnostics). Make sure rapid card test (Pv + Pf) based on the principle of immunochromatography was used for the detection of malarial parasites. For detection of syphilis RPR (Rapid Plasma Reagin) test kit from ARKAY Health care private limited was used. Screening was done as per instructions of manufacturers in the department of transfusion medicine. The seropositive blood products were discarded as per guidelines.

**Quality Control**

Internal and external quality controls were carried out.

**Data Analysis**

Data was collected and entered into Microsoft Excel. The analysis was conducted to assess the positivity rate of the transfusion transmissible infections, distribution by age groups and gender. The results were presented using tables, charts, and graphs. Data analysis was done using statistical package for social sciences (SPSS) software. Descriptive data has been summarized using frequency and percentage. Bivariate analysis done and statistical significance was assessed using chi-square test.

**RESULTS**

A total of 13,262 healthy donors were screened over a period of six months. Among the blood donors, 13,014 (98.1 %) were males and 248 (1.9 %) were females. Their age ranged from 18 to 60 years. Among the 13,262 number of blood donors, 7 (0.052%) were HBsAg positive, 3 (0.02%) were HIV-positive. RPR reactivity was seen only in 2 donors (0.01 %). No blood donor tested showed positivity for HCV or malarial parasite.

Sl. No.	Age	Sex
1	29	Male
2	26	Male
3	18	Male
4	23	Male
5	20	Male
6	25	Male
7	28	Male

**Table 1. HBsAg - Positive - 7 Cases**

Sl. No.	Age	Sex
1	27	Male
2	18	Male
3	40	Male

**Table 2. HIV - Positive - 3 Cases**

Sl. No.	Age	Sex
1	47	Male
2	27	Male

**Table 3. RPR - Positive - 2 Cases**

	18 - 24	25 - 34	35 & Above	Total
HBSAG positive	4	3	0	7
HIV positive	1	1	1	3
Syphilis positive	0	1	1	2
<b>Total</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>12</b>

P value 0.358, chi square value 4.371

**Table 4. Age - Wise Distribution of Transfusion Transmitted Diseases**

	Positive	Negative	Total
Male	12	13,002	13014
Female	0	248	248
<b>Total</b>	<b>12</b>	<b>13250</b>	<b>13262</b>

P value 0.63, chi-square value 0.23

**Table 5. Sex - Wise Distribution of Transfusion Transmitted Diseases**

**DISCUSSION**

The blood transfusion refers to the administration of donated blood or blood products to replace the lost components due to injury surgery or child birth. Blood transfusion considered as a major source of nosocomial infection Globally, more than 81 million units of blood are donated each year. Post transfusion infections are one of the undesirable side effects of blood transfusion. Transfusions of incompetently screened blood or blood products are considered as the potential source of TTIs and can be fatal instead of saving life. In order to be transmissible by blood, the infectious agent has to be present in the blood for long period, stable at 4°C or lower, or in window period, or in asymptomatic phase or only with mild symptoms in the blood donor.

Screening for transfusion transmitted infections is a critical part of the blood transfusion process. The common transfusion transmitted infection is of viral origin, which is potentially transmitted during the immunological window period. Transfusion transmitted viral infections are mainly by HCV, HIV, and HBV rarely by cytomegalovirus, human T cell lymphotropic viruses, zika virus, parvovirus B19 and west Nile virus. Treponema pallidum is the most important bacteria transmitted by blood transfusion. *Leptospira interrogans*, *Borrelia burgdorferi*, *Anaplasma phagocytophilum* and *Rickettsia rickettsiae* are transmitted rarely through blood transfusion.

Incidences of transfusion transmitted parasitic infections are lower when compared to viral and bacterial infections. Malarial parasites are the major cause of transfusion transmitted parasitic infections. Malarial parasite is an intraerythrocytic parasite which can be transmitted via blood transfusion from infected donors. The risk of transfusion malaria is very low in non-endemic areas. The risk of transfusion malaria is higher in transfusion of fresh, whole blood. Transfusion malaria has a shorter incubation period. In some areas of India, malaria is endemic. Donors with history of malaria within three months are deferred from donating blood. Parasites like *Trypanosoma cruzi*, *Babesia microti*, *Toxoplasma gondii* and *Leishmania donovani* are transmitted rarely through blood transfusion. According to the world health organization's (WHO) recommendation the screening should be performed for at least five WHO recommended transfusion transmitted infections which include HCV, HIV, HBV, malarial parasite and syphilis. The prevalence of these blood-borne infections among blood donors may reflect the burden of these diseases among populations in developing countries.

This cross-sectional study was undertaken during January 2018 to June 2018 to focus on the magnitude of blood-borne infections among blood donors. Pre-transfusion screening for transfusion transmitted infections was carried out in 13,262 healthy donors for HIV, HBsAg, HCV, syphilis and malaria. This study outlines the prevalence of transfusion transmitted infections in healthy blood donors in Kozhikode and nearby districts in the state of Kerala.

The present study shows prevalence rate of TTI as 0.092. In this study prevalence of hepatitis B was highest (0.052) followed by HIV (0.02%) and syphilis (0.02%). In a study by Arora D. et al. the seroprevalence of HBV, HCV and syphilis was 1.7 %, 1.0 % and 0.9 % respectively in total donors.<sup>7</sup> The prevalence of HCV, HIV and HBsAg was 0.66 % ranging from 1.01 % in 2002 to 0.29 % , 0.56 % ranging from 0.70 % to 0.44 % and 2.23 % ranging from 2.42 % to 1.97 % respectively in a three year study from 2002 to 2005<sup>6</sup> by Pahuja et al. According to Chandra et al.<sup>8</sup> seropositivity of transfusion transmitted disease in donors was 1.96 % in HBsAg, 0.85 % in hepatitis C virus, 0.23 % in HIV and 0.01 % in syphilis. In a study by Rawat A. et al. the seroprevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus, syphilis and malaria were 0.32, 1.61, 0.73, 1.62 and 0.06 percent.<sup>10</sup>

The majority of the donors in the present study were males (98.1 %) with a very small percentage (1.9 %) of female donors. The male dominance in donation seen in a study by Pahuja et al.<sup>6</sup> According to these studies, males formed the major part of the donor population (97.24 %). Transfusion transmissible infections are seen in males only in our study. None of the female donors screened were positive for any transfusion transmitted diseases which could be attributed to the small sample size. Less female contribution may be due to lack of awareness and enthusiasm among family members of potential female blood donors. Among donors, HBV turned out to be the most prevalent life threatening TTI.

In this study prevalence of HBs Ag is 0.052. The seroprevalence of HBsAg among blood donors varied from

0.34 to 1.96<sup>7,8,9,10</sup> in other studies. Prevalence of Hepatitis B was 1.7 % among blood donors in Southern Haryana.<sup>7</sup> Seroprevalence of hepatitis B virus was 1.61 seen in Delhi, North India, in a study by Rawat A. et al. In a study from Orissa, 1.13 % of blood donors were positive for hepatitis B. A study in South India in Karnataka by K Lathamani et al. showed prevalence of Hepatitis B as 0.53 %.<sup>13</sup>

In this study, the prevalence of HIV is 0.022 percent. Prevalence of HIV among blood donors in India varied from 0.06 to 0.44 in different studies.<sup>7,8,9,10,11</sup> Importance of transfusion transmitted HIV is that the rate of seroconversion is very high when HIV is transmitted through blood and blood components. Seroprevalence of HIV was 0.08 percent among voluntary donors and 0.15 percent among replacement donors in a study at Lucknow by Chandra T et al. Seroprevalence of HIV 0.32 per cent was found in Delhi by Rawat et al. A study in Karnataka showed the prevalence of 0.08 % of HIV among blood donors.<sup>13</sup>

Syphilis is mainly transmitted by sexual contact; it may be transmitted by transfusion of blood and blood components donated by symptomatic donors. RPR reactivity was seen only in 2 donors (0.01%) in this study. Prevalence of syphilis varied from 0.01 % to 1.62 %<sup>7,8,9,10,13</sup> in various other studies. Prevalence of syphilis was 0.9 % among blood donors in southern Haryana<sup>7</sup> and it is 1.62 % in Delhi.<sup>10</sup> In study by K Lathamani et al. in Karnataka showed a prevalence rate of syphilis as 0.09 %.<sup>13</sup> Prevalence rate of syphilis in the current study was lower than various other studies.<sup>14,15</sup> In a study conducted in India by Dobariya et al.<sup>14</sup> out of 40,971 donors, 67 (0.16 %) donors were positive for syphilis. Overall seroprevalence of syphilis 0.28 % was seen in a five-year study by Chandekar et al.<sup>15</sup>

The hepatitis C virus is transmitted via transfusion of unscreened blood and blood products, injection drug use, unsafe injection practices and sexual route. Acute cases of hepatitis C are usually mild but it may progress to chronic blood borne infection or chronic liver disease. Chances of cirrhosis and hepatocellular carcinoma by HCV are more than HBV. Introduction of anti HCV screening for blood donors have led to decrease in incidence of transfusion transmitted HCV. No one was positive for HCV in our study. There was a wide variation in prevalence of HCV ranging from 0.06 % to 1.02 % reported in other studies.<sup>7,8,9,10,11</sup> Study by Arora D et al. in southern Haryana showed a prevalence of 1.0 % of hepatitis C. Study in Delhi showed seroprevalence of 0.73 percent. Study from Mumbai showed seroprevalence of 0.25 percentage.<sup>4</sup> In a study from Karnataka, South India prevalence of HCV was 0.098 %. Higher HCV prevalence were reported in Southeast Asian countries, including India (1.5 %), Malaysia (2.3 %), Philippines (2.3 %), Pakistan (8.1 %), and in equatorial Africa (6.5 %), as high as 20 % in Egypt.<sup>16</sup>

Syphilis is mainly transmitted by sexual contact. It may be transmitted by transfusion of blood and blood components donated by symptomatic donors. RPR reactivity was seen only in 2 donors (0.01 %) in this study. Prevalence rate of syphilis in the current study was lower than various other studies.<sup>14,15</sup> In a study conducted in India by Dobariya et al.<sup>15</sup> Out of 40,971 donors, 67 (0.16%) donors were

positive for syphilis. Overall seroprevalence of syphilis 0.28 % seen in a five-year study by Chandekar et al.<sup>16</sup>

Malarial parasite is an intraerythrocytic parasite which can be transmitted via blood transfusion from infected donors. None of the donors tested were positive for malaria in our study. In the study by Sreekrishna A et al.<sup>9</sup> Out of 8,617 donors, no malarial parasites were picked up. Prevalence of malaria among blood donors varied from nil to 0.06 in various studies.<sup>7,8,12</sup> Seropositivity for malaria was found to be low at 0.06 percent in a study conducted in Delhi.<sup>10</sup> Only one (0.01 %) voluntary blood donor was tested positive for malarial parasite<sup>12</sup> in a study at Mangalore. Malaria was found to be present in 0.03, 0.33, and 0.57 % in studies from India, Nepal, and Pakistan (Bahadur et al., Ghimire et al., and Ali et al.<sup>17,18,19</sup> respectively.

This study showed the highest prevalence (0.052) for HBsAg among transfusion transmitted diseases. The incidence of HBsAg was 2.6 % in 2006, 2.67 % in 2007 and 3.43 % in 2008 in a three-year study by Nilima Sawke et al. and overall incidence was 2.9 %.<sup>20</sup>

In our study the majority of donors who were positive for transfusion transmitted diseases belonged to the age group 18 to 30. Study by Panda M et al. from Orissa, HIV and HCV was most prevalent in 21 to 30 years age group.<sup>21</sup>

Prevalence of transfusion transmitted diseases among blood donors in our study was comparatively less than the prevalence in other studies. Less prevalence may be due to strict donor screening criteria in our institution, and a large number of voluntary donors. Less prevalence of the transfusion transmitted diseases in the region also contributed to the lesser prevalence of transfusion transmitted diseases in this study. Only with continuous implementation of proper donor screening, new effective screening procedures, and implementation of virus inactivation technology, transfusion transmitted infections can be decreased.

## CONCLUSIONS

To conclude, HBV is the common transfusion transmissible infection among apparently healthy donors, followed by HIV and syphilis. The overall prevalence of transfusion transmissible infections among blood donors differs around the world, which reflects the variation in the prevalence of these infections. Transfusion transmitted infections which threaten safety of the recipients and the community as a whole can be eliminated by implementation of strict donor eligibility criteria, meticulous donor screening and more sophisticated as well as highly sensitive techniques for detection of antibody, antigen and viral genome. Asymptomatic donors and donors in the window period are major sources of transfusion transmitted diseases that can be eliminated only by screening of donors by blood bank counsellors. Because of strict screening in blood banks, incidences of transfusion transmitted infections remain very low nowadays. Avoiding unnecessary transfusions can also decrease the risk of transfusion transmitted infections. Involvement of more organizations to create the awareness among common people about screening and voluntary blood

donation may reduce the transmission transmissible infections.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

## REFERENCES

- [1] Widman FK. Technical manual. Arlington: American Association of Blood Banks 1985: p. 325-344.
- [2] Kar HK. Global and national overview of HIV/AIDS epidemic. In: Sharma VK, edr. Sexually transmitted diseases and HIV/AIDS. 2<sup>nd</sup> edn. New Delhi: Viva Books Pvt. Ltd., 2009: p. 99-109.
- [3] Chandra T, Rizvi SNF, Agarwal D. Decreasing prevalence of transfusion transmitted infection in Indian scenario. Scientific World Journal 2014;2014:173939. [www.hindawi.com/journals/tswj/2014/173939](http://www.hindawi.com/journals/tswj/2014/173939)
- [4] Chandekar SA, Amonkar GP, Desai HM, et al. Seroprevalence of transfusion transmitted infections in healthy blood donors: a 5-year tertiary care hospital experience. J Lab Physicians 2017;9(4):283-287.
- [5] Kakkar N, Kaur R, Dhanoa J. Voluntary donors—need for a second look. Indian J Pathol Microbiol 2004;47(3):381-383.
- [6] Pahuja S, Sharma M, Baitha B, et al. Prevalence and trends of markers of hepatitis C virus, hepatitis B virus and human immunodeficiency virus in Delhi blood donors: a hospital based study. Jpn J Infect Dis 2007;60(6):389-391.
- [7] Arora D, Arora B, Khetarpal A. Seroprevalence of HIV, HBV, HCV and syphilis in blood donors in Southern Haryana. Indian J Pathol Microbiol 2010;53(2):308-309.
- [8] Chandra T, Kumar A, Gupta A. Prevalence of transfusion transmitted infections in blood donors: an Indian experience. Trop Doct 2009;39(3):152-154.
- [9] Srikrishna A, Sitalakshmi S, Damodar P. How safe are our safe donors? Indian J Pathol Microbiol 1999;42(4):411-416.
- [10] Rawat A, Diwaker P, Gogoi P, et al. Seroprevalence & changing trends of transfusion-transmitted infections amongst blood donors in a Regional Blood Transfusion Centre in north India. Indian J Med Res 2017;146(5):642-645.
- [11] Makroo RN, Chowdhry M, Bhatia A, et al. Prevalence of HIV among blood donors in a tertiary care centre of north India. Indian J Med Res 2011;134(6):950-953.
- [12] Fernandes H, D'Souza PF. Prevalence of transfusion transmitted infections in voluntary and replacement donors. Indian J Hematol Blood Transfus 2010;26(3):89-91.
- [13] Lathamani K, Bhaktha G, Nayak S, et al. Prevalence of HIV, HCV, HBV and Syphilis in blood donors among the Dakshina Kannada District, India. Int J Curr Microbiol App Sci 2013;2(10):249-252.
- [14] Dobariya GH, Raja KA, Unagar CA, et al. Prevalence and trends of transfusion transmitted infections among

- blood donors of blood bank attached to government hospital of South Gujarat. India. *Int J Res Med Sci* 2016;4(9):4123-4127.
- [15] Chandekar SA, Amonkar GP, Desai HM, et al. Seroprevalence of transfusion transmitted infections in healthy blood donors: a 5-year tertiary care hospital experience. *Journal of Laboratory Physicians* 2017;9(4):283-287.
- [16] Khodabandehloo M, Roshani D, Sayehmiri K. Prevalence and trend of hepatitis C virus infection among blood donors in Iran: a systematic review and meta-analysis. *J Res Med Sci* 2013;18(8):674-682.
- [17] Bahadur S, Pujani M, Jain M. Use of rapid detection tests to prevent transfusion-transmitted malaria in India. *Asian J Transfus Sci* 2010;4(2):140-141.
- [18] Ghimire P, Dhungyei BB, Tiwari BR. Hepatitis B and Malaria among Nepalese blood donors. *Scientific World* 2007;5(5):81-84.
- [19] Ali N, Ahmed J, Ali N, et al. Transfusion transmitted malaria in three major blood banks of Peshawar, Pakistan. *Afr J Biotechnol* 2010;9(33):5445-5449.
- [20] Sawke N, Sawke GK, Chawla S. Seroprevalence of common transfusion transmitted infections among blood donors. *People's Journal of Scientific Research* 2010;3(1).
- [21] Panda M, Kar K. HIV, hepatitis B and C infection status of the blood donors in a blood bank of a tertiary health care centre of Orissa. *Indian J Public Health* 2008;52(1):43-44.