

Prevalence and trends of transfusion transmissible infections among blood donors in Basra, Iraq

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ABSTRACT

Background Despite saving millions of lives through blood transfusion, transfusion-transmissible infections (TTIs) still threaten the lives of patients requiring blood transfusion. Hence, screening blood donors and studying the prevalence of TTIs among blood donors may display the burden of these diseases among our population. The aim of this study was to assess the seroprevalence rates of transfusion transmitted infections among blood donors in Basra, Iraq from 2019 to 2021 as groundwork for providing safe blood transfusion in Iraq.

Methods A cross-sectional study was carried out in the blood banks in Basra, Iraq from 1 January 2019 to 31 December 2021. A total of 197 898 samples were collected and screened for hepatitis B surface antigen (HBsAg), anti-hepatitis B core (HbC), anti-hepatitis C virus (HCV) and syphilis immunologically.

Results The prevalence rates of seropositive of viral hepatitis for the year 2019, 2020, 2021 were as following: hepatitis B virus (HBV) rates 1.54%, 1.45% and 1.14% with significant declined trend by 26%; anti-HCV rates were 0.14, 0.12 and 0.11% with significant declined trend by 21.4%; and the syphilis rates were 0.38, 0.47, 0.36 with marked declined trend 5.3%, respectively. Of those donors showed HBV positive, 2503 (1.26%) had positive anti-HbC results, while only 173 (0.0874) showed positive test results for both anti-HbC and HBsAg.

Conclusion Prevalence rates of viral hepatitis and syphilis showed a steady decline between 2019 and 2021, and these rates were much lower in Basra than in other parts of Iraq and neighbouring countries. The importance of using the anti-HbC test in the screening of blood donors was indicated in this study. These findings would contribute in improving the understanding of TTIs epidemiology and supporting health authorities controlling bloodborne diseases.

INTRODUCTION

Blood transfusion is an essential and life-saving scheme in modern medicine; however, it still remains as a potential route of transmission of transfusion-transmissible infections (TTIs) including HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis and many other diseases.^{1–3} According to WHO reports in 2018, the prevalence of HIV, HBV, HCV and syphilis infections among blood

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Transfusion-related infections (TTIs) remain the main threat to life of blood recipients.
- ⇒ Prevalence of TTIs infection in low-income countries is much higher than developed countries.

WHAT THIS STUDY ADDS

- ⇒ The prevalence rates of hepatitis B and C and syphilis infections among blood donors in Basra showed a steady decline between 2019 and 2021, these rates are comparatively lower than other Iraqi provinces and other neighbouring countries.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Improving the understanding of the epidemiology of TTIs and highlight the importance of continuous efforts to create awareness among public health to implement effective and preventive strategies, in order to eliminate the transmission of these infections.

donations collected globally varies from 0.003% to 1.08%, 0.03% to 3.70%, 0.02% to 1.03% and 0.05% to 0.90% respectively, with lower prevalence in high-income countries.⁴ Therefore, TTIs were considered to be major threats for the blood recipients and a leading concern for the public health authorities.⁵ Accordingly, the WHO recommends that all blood donations must be tested for these infectious diseases.⁴ Nowadays, screening of the donated blood for TTIs is compulsory and carried out regularly in blood banks.

Supplying safe blood requires improved quality blood transfusion services and moderated infrastructure along with suitably competent staff.⁶ The prevention of TTIs in low-income and middle-income countries is a vast challenge due to the insufficient resources and lack of accessibility. In Iraq, although regulations are implemented on the compulsory screening of TTIs nevertheless transmission of diseases still follows. This may be due to a lack of the sensitivity or failure



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of screening assay to detect the infection in the window phase. Hence, complete surveillance and following control of TTIs among the blood donors is essential to assure blood safety. Also, reviewing and studying of the records of blood donors for screening protocols are necessary for assessment of the safety of the blood supply and the risk transfusion transmitted infectious diseases (TTIs). In Iraq, studies demonstrated that the prevalence of hepatitis B has declined from 4.1% to less than 1% in the period of seventies to twenties.⁷⁻⁹ One local study showed that the rate of anti-HCV was 1.2% in Baghdad.⁸ However, other study explored thoughtful concerns about the HBV and HCV which were found to be intermediate to highly endemic infections in our country.¹⁰ In spite of the importance of the studying TTI epidemiology in Iraq, available information on TTI prevalence is insufficient. The main limitations of these studies are that they were conducted locally with a small sample size and focused on specific hepatitis seromarkers. This study was carried out to denote the occurrence of HBV, HCV and syphilis infections in the blood donors and to assess the trend of these bloodborne infections in Basra province from 2019 to 2021. Thus, this study not only affords updated information on the prevalence of TTIs; it is also more inclusive given the larger sample size and the longer study duration (3 years) showing the trend of these infections of the study period.

MATERIALS AND METHODS

This was a cross-sectional 3-year descriptive study of consecutive blood donor's records covering the period from 1 January 2019 to 31 December 2021. The study was

conducted at the Central Blood Bank (in Basra city/Iraq). Selection of potential donors based on their medical history and the outcome of clinical examination by physician. People who have serious illness, recent history of medication, previous blood transfusion, current surgical procedure, pregnant and lactating women or over 60 years were excluded. None of the participants had a history of HBV vaccination. Sociodemographic data (age, sex, residence, etc) were recorded at the Central Blood Bank (in Basra city centre). A total of 197 898 healthy blood donors (20–60 years) were included in this study.

The serum samples of all blood donors were screened for viral infections including hepatitis B surface antigen (HBsAg), antibodies to anti-hepatitis B core (HBc), antibodies to hepatitis C antigen (anti-HCV), antibodies to HIV 1 and 2 and antibodies to *Treponema pallidum* using the ELISA kit (BioKits), following manufacturer's instructions.

Statistical analysis was carried out by using SPSS Statistics V.19.0. A $p \leq 0.05$ was considered statistically significant.

RESULTS

A total of 197 898 blood donations including 197 684 (99.9%) males and 214 (0.1%) females were subjected to screening for HBV, HCV, HIV and syphilis infections. The age of the participants ranged from 20 to 60 years (median 30 years), most of the blood donors were between 30 and 40 years old.

Out of 197 898, a total of 3756 (1.9%) donors showed positive result for at least one screening test. Regarding

Table 1 Seroprevalence of transfusion transmittable infections among donor blood samples

Year	Tested donors (no)	Hepatitis B (%)	Hepatitis C (%)	Syphilis (%)	Total positive results (%)	Total donors with positive results (%)	Total tested
2019	Male donors (70268)	1086 (1.54)	96 (0.13)	264 (0.37)	1446 (2.1)	1552 (2.1)	70 351
	Female donors (83)	0 (0)	1 (1.2)	5 (6)	6 (7.2)		
2020	Male donors (57814)	838 (1.45)	70 (0.12)	272 (0.47)	1180 (2.04)	1181 (2.04)	57 860
	Female donors (46)	0 (0)	0 (0)	1 (2.2)	1 (2.2)		
2021	Male donors (69566)	795 (1.14)	76 (0.11)	248 (0.36)	1119 (1.61)	1123 (1.61)	69 651
	Female donors (85)	1 (1.2)	1 (1.2)	2 (2.4)	4 (4.7)		
Tested donors within 3 years (%)	Male donors 197 684 (99.9)	2719 (1.38)	242 (0.12)	784 (0.4)	3745 (1.89)	3756 (1.9)	197 898
	Female donors 214 (0.1)	1 (0.46)	2 (0.93)	8 (3.7)	11 (5.14)		
Total donors with positive results (%)		2720 (1.374)	244 (0.123)	792 (0.4)			

Out of 197898 tested donors, 3756 (1.9%) showed a positive result for at least one screening test (Hepatitis C, Syphilis) during the three-year period.

Table 2 Seromarkers of hepatitis B among blood donors (2019–2021)

Tests	HBsAg				P value*
	Positive (%)	Negative (%)	Total (%)		
HBcAb	Positive (%)	173 (0.0874)	2330 (1.2)	2503 (1.26)	X ² =8154.0817 <0.00001
	Negative (%)	44 (0.022)	195 351 (98.7)	195 395 (98.7)	
Total (%)	217 (0.11)	197 681 (99.9)	197 898 (100)		

*The result is significant at p<0.05.
HBcAb, hepatitis B core antibodies; HBsAg, hepatitis B surface antigen.

the screening for HBV, 2720/197 898 (1.374%) donors have shown positive results for HBV infection; of whom 2503/197 898 (1.26%) donors had positive test results for anti-HBc, 217/197 898 (0.11%) donors had positive test results for HBsAg, and only 173 (0.0874) showed positive results for both anti-HBc and HBsAg (tables 1 and 2). Male donors showed higher positive HBV than female donors (table 1).

As shown in table 1, 244/197 898 (0.123%) blood donors had positive results for the anti-HCV antibody; males 242/197 684 (0.12%) and females 2/214 (0.93%). Regarding the screening for syphilis, 792/197 898 (0.4%) donors showed positive results; from which 784/197 684 (0.4) were males and 8/214 (3.7%) were females (table 1).

Table 3 and figure 1 illustrate the overall and annual TTIs positive result rates among blood donors from 2019 to 2021. During this study period, the HBV, HCV, syphilis and the total positive results reduced by 26%, 21.4%, 5.3% and 23.8%, respectively, decreasing from 1.54% to

1.14% (p<0.01), 0.14% to 0.11% (p=0.089), 0.38% to 0.36% (p=0.582), and 2.1% to 1.6% (p<0.01), respectively. Nineteen (0.0096%) of the screened blood donors were coinfecting; 14 (0.007%) with HBV-HCV and 5 (0.0025%) with HCV-syphilis. HIV results were not included in this study due to the inaccessibility of these data.

DISCUSSION

Though millions of lives are being saved through blood transfusion, it remains a potential route of transmitting infections. Hence, screening blood donors for blood born infection is essential to protect blood recipients from transmission of these infections.

In this study, the majority of donated blood was by males (99.9%), which was similar to many studies.^{11–13} Globally, it was reported that 33% of donated blood given by females. However, the contribution of females is less than 10% in 14 out of 111 countries.⁴ This could be due to various factors, including physiological factors such as menstruation, milk feeding and pregnancy.¹⁴ Generally, most blood donors are young people, below 30 years, as shown in many studies.^{15–17} In this study, most of the blood donors were between 30 and 40 years old. In addition, most of the positive results were found more in younger people, which also stated by other studies in different regions.^{15–20}

According to the previous studies, the prevalence of TTIs among the blood donors in Iraq was varied; HBV (0.7%–3.5%), HCV (0.2%–0.5%) and syphilis

Table 3 The time-based change trend of positive results among blood donors in Basra/ Iraq, in the period 2019–2021

Tests	Donors with positive results			Change (%)*
	2019 n=70 351 no (%)	2020 n=57 860 no (%)	2021 n=69 651 no (%)	
HBV	1086 (1.54)	838 (1.45)	796 (1.14)	–26 X ² =54.179 p<0.01
HBC	97 (0.14)	70 (0.12)	77 (0.11)	–21.4 X ² =4.828 p=0.089
Syphilis	269 (0.38)	272 (0.47)	250 (0.36)	–5.3 X ² =1.080 p=0.582
Total positive results	1452 (2.1)	1180 (2.04)	1123 (1.6)	–23.8 X ² =49.394 p<0.01

Positive test rate (%)=(the number of each positive test/ the total of corresponding tested blood donors in the same year)×100%. The % changes were calculated in the following way: (positive results in 2021–positive results in 2019)/positive results in 2019.
*The result is significant at p<0.05.
HPC, hepatitis C virus; HPV, hepatitis B virus.

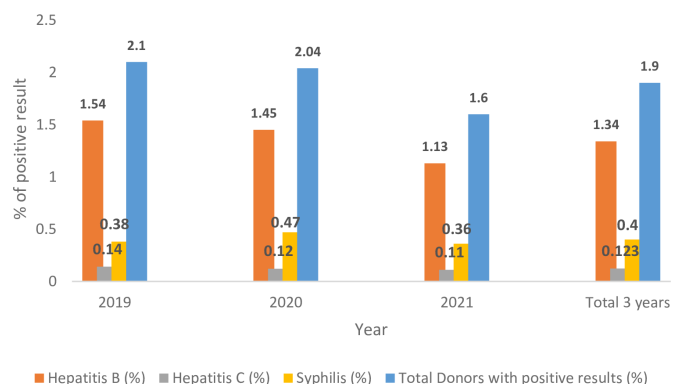


Figure 1 Frequency of bloodborne infections among blood donors in Basra province during the period study (2019–2021).



(0.26%–1.1%).^{7–10 18–20} The present results showed that the seroprevalence of HBV, HCV and syphilis, in 2021, were 1.14%, 0.11% and 0.36%, respectively, which is within the ranges or less than the previous national studies. Furthermore, the current findings showed that the prevalence of TTIs is less than prevalence reported by WHO in low income countries HBV 3.70, HCV 1.03 and syphilis 0.9%, but still higher than that reported in high-income countries, 0.03%, 0.02% and 0.05%, respectively.⁴

Our results showed that the prevalence of HCV and syphilis in female donors was higher than that in males; 0.93 vs 0.12 and 3.7 vs 0.4, respectively. However, this needs to be confirmed by other study with large sample size and nationwide survey.

In this study, the positivity rates of TTIs were assessed through the years 2019 to 2021. Throughout this study we were able to categorise the trend of these infections, which found to be decreased over the study period. This decreasing in the trend of TTI infections is the result of the effective of the implemented prevention and control programmes such as vaccination programme and safe blood transfusion giving all donated blood subjected to screening tests prior transfusion.

The present results showed that the prevalence of HBsAg during the study period (2019–2021) was 0.1%, which is less than what has been found in other parts of the country including Baghdad (0.6%), Babylon province (0.7%), Najaf governorate (0.66%), Karbala (3.5%) and Kurdistan region (0.78%).^{8–10 18 19} Also, the present rate is less than that has been stated in other previous studies in Basra province (0.2%).⁷ In addition, the prevalence of HBsAg in blood donors in Basra is less than what has been reported from other countries in the region including Qatar, Jordan, Sudan, Egypt, Saudi Arabia, Lebanon, Iran and Pakistan.^{11 21–26}

As indicated in our study, screening blood donors for HBsAg alone is not adequate to exclude HBV from the blood supply, especially during the core window period. This may lead to post-transfusion hepatitis B in the recipient.²⁷ Therefore, screening for anti-HBc is significantly effective in reducing the occurrence of post-transfusion hepatitis B infection.^{28 29} In Iraq, testing for anti-HBc has been implemented in the screening protocol donated blood.⁹ However, it is crucial to implement HBV DNA screening among blood donors in Iraq to eliminate the risk of HBV transmission through blood transfusion.³⁰

Our study showed that the rates for anti-HBc displayed a varying trend between 0.14 in 2019 and 0.12 in 2021. These rates are less than the reported from previous study in Iraq including Baghdad (0.7%), Babylon governorate (0.5%) and other countries in the region such as Jordan (3.09%), Qatar (0.7%) and Saudi Arabia (9.81%).^{8–11 26}

This study found that the rate of syphilis among the blood donors throughout the study period varied from 0.38 in 2019 to 0.47% and 0.36% in 2020 and 2021, respectively.

These rates were higher in women than male, but this needs to be confirmed. Yet, these rates are less than what

was found in other parts of Iraq including Karbala governorate (0.76%), Anbar province in the west of Iraq (1.09%), in the Arab world and foreign countries including Qatar (0.45), Saudi Arabia (0.53), Sudan (6.6%), Pakistan (3.1%) and China (0.88%).^{11 20 22 31–34}

The valuable importance of this study is based on a large-scale study covering a large sample size for long periods to examine the trends of the prevalence of sero-markers in blood donors in Basra province. The current findings will benefit in establishing a valued ground for evaluation in upcoming studies. Yet, there are some limitations worth stating. The main limitation of this study is that the data obtained may not reflect the actual prevalence in the whole society as it involved only blood donors. The second limitation is the lack of research and data of patients with association of risk factors as well as the outcome of donors with seropositive results due to unattainable history of blood donors. Another limitation is not including data about HIV, due to the inaccessibility of this data. For further study, we recommend employing an advanced test such as HBV DNA to enhance the detection methods to detect HBV infections. However, this test is currently unavailable in many areas in Iraq because of limited resources.

Despite the limitations mentioned above, this study still delivers valuable conclusion that will help in improving the understanding of TTIs epidemiology and supporting health authorities controlling bloodborne diseases. Up to our knowledge, this is the first large-scale study to investigate the prevalence of in blood donors in Basra province. Further nationwide studies are required to evaluate the circulation and the risk factors of these infections to develop an effective and preventive strategies to protect our community from possible risks.

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Disclaimer

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REFERENCES

- 1 Biadgo B, Shiferaw E, Woldu B, *et al*. Transfusion transmissible viral infections among blood donors at the North Gondar district blood bank, Northwest Ethiopia: a three-year retrospective study. *PLoS ONE* 2017;12:e0180416.
- 2 Osei E, Lokpo SY, Agboli E. Sero-prevalence of hepatitis B infection among blood donors in a secondary care hospital, Ghana: a retrospective analysis. *BMC Res Notes* 2017;10:391.
- 3 Sehgal S, Shaiji PS, Brar RK. Sero-prevalence and trends of transfusion transmissible infections in blood donors in Andaman and Nicobar Islands—an institutional retrospective study. *J Clin Diagn Res* 2017;11:EC21–4.
- 4 World Health Organization (WHO). Blood safety and availability [WHO]. 2017. Available: <http://www.who.int/mediacentre/factsheets/fs279/en/>
- 5 Bisetegen FS, Bekele FB, Ageru TA, *et al*. Transfusion-transmissible infections among voluntary blood donors at Wolaita Sodo University teaching referral hospital, South Ethiopia. *Can J Infect Dis Med Microbiol* 2016;2016:8254343.
- 6 Osaro E, Charles AT. The challenges of meeting the blood transfusion requirements in sub-Saharan Africa: the need for the development of alternatives to Allogenic blood. *J Blood Med* 2011;2:7–21.
- 7 Al-Rubaye A, Tariq Z, Alrubaiy L. Prevalence of hepatitis B seromarkers and hepatitis C antibodies in blood donors in Basra, Iraq. *BMJ Open Gastroenterol* 2016;3:e000067.
- 8 Ataallah TM, Hanan KA, Maysoun KS, *et al*. Prevalence of hepatitis B and C among blood donors attending the National blood transfusion center in Baghdad, Iraq from 2006–2009. *Saudi Med J* 2011;32:1046–50.
- 9 Al-Juboury AWF, Salih HA, Al-Assadi MK, *et al*. Seroprevalence of hepatitis B and C among blood donors in Babylon Governorate-Iraq. *Med J Babylon* 2010;7:1–2.
- 10 Al-Hamdani AH, Al-Rawy SK, Khamees HA. Retrospective seroprevalence study of hepatitis B and C in Iraqi population at Baghdad: a hospital based study. *Iraqi J Comm Med J* 2012.
- 11 Aabdien M, Selim N, Himatt S, *et al*. Prevalence and trends of transfusion transmissible infections among blood donors in the state of Qatar, 2013–2017. *BMC Infect Dis* 2020;20:617.
- 12 Kasraian L, Ashkani-Esfahani S, Forouzandeh H. Reasons of under-representation of Iranian women in blood donation. *Hematol Transfus Cell Ther* 2021;43:256–62.
- 13 Alcantara JC, Alenezi FKM, Haj Ali OH. Seroprevalence and trends of markers of transfusion transmissible infections among blood donors: a 3-year hospital based-study. *Int J Community Med Public Health* 2018;5:5031.
- 14 Bani M, Giussani B. Gender differences in giving blood: a review of the literature. *Blood Transfus* 2010;8:278–87.
- 15 El-Hazmi MM. Prevalence of HBV, HCV, HIV-1, 2 And HTLV-I/II infections among blood donors in a teaching hospital in the central region of Saudi Arabia. *Saudi Med J* 2004;25:26–33.
- 16 Farshadpour F, Taherkhani R, Tajbakhsh S, *et al*. Prevalence and trends of transfusion-transmissible viral infections among blood donors in south of Iran: an eleven-year retrospective study. *PLoS One* 2016;11:e0157615.
- 17 Ji Z-H, Li C-Y, Lv Y-G, *et al*. The prevalence and trends of transfusion-transmissible infectious pathogens among first-time, voluntary blood donors in Xi'An, China between 1999 and 2009. *Int J Infect Dis* 2013;17:e259–62.
- 18 Rasheed Hussein N, Mohamad Haj S, Amin Almizori L, *et al*. The prevalence of hepatitis B and C viruses among blood donors attending blood bank in Duhok, Kurdistan region, Iraq. *Int J Infect* 2016;4.
- 19 Mahmood AK, Addose SA, Salih HA, *et al*. Seroprevalence of HBs AG and anti HCV positive blood donors in Najaf Governorate. *Iraqi J Community Med* 2001;14:29–33.
- 20 Hassan SH. Prevalence of Syphilis in blood donors over one year in Karbala Governorate, Iraq. *Indian J Public Health Res Dev* 2020;11:1551–5.
- 21 Souan L, Siag M, Al-Salahat H, *et al*. Changing trends in Seroprevalence rates of transfusion-transmitted diseases among blood donors in Jordan. *BMC Infect Dis* 2021;21:508.
- 22 Almugadam BS, Ibrahim OMA, Ahmed YMA. Seroprevalence of the serological markers of transfusion-transmissible infections among volunteer blood donors of Kosti obstetrics and Gynecology hospital. *Medicines (Basel)* 2021;8:64.
- 23 Hussein E. Blood donor recruitment strategies and their impact on blood safety in Egypt. *Transfus Apher Sci* 2014;50:63–7.
- 24 Aljumah AA, Babatin M, Hashim A, *et al*. Hepatitis B care pathway in Saudi Arabia: current situation, gaps and actions. *Saudi J Gastroenterol* 2019;25:73–80.
- 25 Saab BR, Nassar NT, Musharrafieh U, *et al*. Prevalence of hepatitis B in a presumably healthy lebanese population. *J Med Liban* 2007;55:11–4.
- 26 Babanejad M, Izadi N, Najafi F, *et al*. The HBsAg prevalence among blood donors from Eastern Mediterranean and Middle Eastern countries: a systematic review and meta-analysis. *Hepat Mon* 2016;16:e35664.
- 27 Kaminski G, Alnaqdy A, Al-Belushi I, *et al*. Evidence of occult hepatitis B virus infection among Omani blood donors: a preliminary study. *Med Princ Pract* 2006;15:368–72.
- 28 Allain JP. Occult hepatitis B virus infection: implications in transfusion. *Vox Sang* 2004;86:83–91.
- 29 Su F-H, Bai C-H, Chu F-Y, *et al*. Significance and Anamnestic response in isolated hepatitis B core antibody-positive individuals 18 years after neonatal hepatitis B virus vaccination in Taiwan. *Vaccine* 2012;30:4034–9.
- 30 Godbey EA, Thibodeaux SR. Ensuring safety of the blood supply in the United States: donor screening, testing, emerging pathogens, and pathogen inactivation. *Semin Hematol* 2019;56:229–35.
- 31 Alaidarous M, Choudhary RK, Waly MI, *et al*. The prevalence of transfusion-transmitted infections and nucleic acid testing among blood donors in Majmaah. *J Infect Public Health* 2018;11:702–6.
- 32 Al-alwani HR. Prevalence of transfusion transmitted infections among blood donors in Al- Anbar province after war displacement period. *J Pharm Sci & Res* 2018;10:3333–5.
- 33 Nazir S, Pracha HS, Khan A, *et al*. Prevalence of syphilis in Pakistani blood donors. *Adv Life Sci* 2013;1:27–30.
- 34 Liu S, Luo L, Xi G, *et al*. Seroprevalence and risk factors on Syphilis among blood donors in Chengdu, China, from 2005 to 2017. *BMC Infect Dis* 2019;19:509.