Seroprevalence and associated risk factors for HIV, Hepatitis B and C among blood Donors in South Gondar District blood Bank, Northwest Ethiopia

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Abstract

Background: Despite the undeniable significance of blood transfusion in saving a millions life in emergencies and medical treatment, the quality of blood faced challenges from transfusion-transmitted infections (TTIs) such as HIV (human immunodeficiency virus), HBV (hepatitis B virus) and HCV (hepatitis C virus). This cross-sectional study was undertaken with the aim of determining the seroprevalence and risk factors of HIV, HBV, and HCV among blood donors.

Method: An institutional based cross-sectional study was conducted at Debre Tabor district hospital from January 2017 to February 2018. Blood samples from volunteer donors collected; serum separated and screened with ELISA tests for detection of anti-HIV, hepatitis-B surface antigen (HBsAg) and anti-HCV. Fishers' exact test was employed to see the association between variables as well logistic regression tests were applied to identify potential risk factors. P-value of less than 0.05 was considered as statistically significant.

Result: A total of 310 volunteer donors were included in the study. The proportion of blood donors having at least one viral-TTI was 12.6% while the magnitudes of HIV, HBV, and HCV were 2.6, 5.8 and 4.2%, respectively. Educational status and multiple sexual behaviors are significantly associated with HIV acquisition whilst marital status was significantly associated with HBsAg seropositivity.

Conclusion: Seroprevalence of transfusion-transmissible infections was high and alarming therefore proper screening of donated blood with test methods having better diagnostic performance should be employed. Also encouragement of blood donation from voluntary donors and creating awareness on the general public regarding HIV, HBsAg and HCV transmission and prevention should be strengthen.

Keywords: Blood transfusion, Transfusion-transmissible infection
Viral TTIs vary globally, in Africa alone, up to 500 peoples acquire TTIs due to contaminated blood transfusion daily [10]. Sub-Saharan Africa inhabited with 38 million HIV infected peoples, remains one of the highest regions as 68% of globally HIV infected people are residing in this region consequently resulting about 15% of HIV transmission through blood transfusion [11, 12]. Global distribution of HBV and HCV infection among blood donors is variable. Findings from Asian study indicated that the magnitude of HBV HCV among blood donors were 1.76 and 0.19% [13], while 0.51 and 0.25% of blood donors in China were positive for HBsAg and HCV respectively [14].

The demand for blood transfusion in Ethiopia has been reported to be high as a result of frequent road traffic accidents, surgical and obstetric blood loss, as well as anemia from other sources [15–17]. Epidemiological studies conducted on TTIs in several regions of Ethiopia showed a magnitude of 43.2, 11.5, 7.0, 5.9, and 3.6% in Bahir Dar, Jijiga, Hawassa, north Gondar, and Jimma respectively [18–22]. Currently, in Ethiopia, several programs are designed and implemented to reduce the transmission and incidence of HBV that includes early child hood vaccination, screening of all pregnant women for HBsAg, and vaccination of high risk target groups like healthcare providers. However, according to WHO, Ethiopia is categorized under regions where viral hepatitis infection ranging from intermediate to hyper-endemic [23]. A systematic review and meta-analysis study conducted in Ethiopia revealed that HBV is highly prevalent among blood donors (8.4%) next to immigrants (11.0%) [24]. It is also documented that viral hepatitis is the most predominant viral-TTI than HIV and HCV among blood donors [18–22].

Assessment of viral-TTIs and potential risk factors is the mainstay for providing a clear picture on the prevalence of these infections among blood donors which ultimately evaluate preventive strategies and take corrective measures. Consequently, data obtained from the study will permit to see the safety of donated bloods for transfusion there by health policy makers may consider a better diagnostic scheme. Also, evaluation of potential risk groups and the extent of factors will strengthen the decision on selection of low-risk donor, proper collection and application of better screening methods thereby, safe and adequate blood donation for transfusion will be guaranteed. However, data are hardly limited in South Gondar, Northwest Ethiopia. Therefore, the objective of the current study was to determine the seroprevalence HIV, HBV, and HCV as well as potential risk factors among blood donors at South Gondar district Blood Bank, northwest Ethiopia.

Methods
Study design and setting
A cross-sectional study was conducted at Debre Tabor Hospital blood bank from January 2017 to February 2018. The hospital is a tertiary level hospital that provides health service to over three million inhabitants and residents found in Debre Tabor city, South Gondar Administrative Zone, Amhara National Regional State, 666 Km north from the capital city, Addis Ababa. The blood bank was established in 2014 G.C.

Study subjects and sampling
For this study, based on the criteria established by the Ethiopian Red Cross Society, all voluntary blood donors who were eligible and donated blood during the study period were included. As the new WHO guide line encourages voluntary blood donation, consecutive blood donors from January 2017 to February 2018 were incorporated.

Sample collection and laboratory analysis
Aliquots of whole blood were taken from blood donors and serological assays for HIV infection [3rd generation ELISA, Vironostika HIV Uni-Form II AG (Bio-Merieux, Boxtel, Netherlands)], HBV [ELISA Hepanostika HBsAg UNi-Form II (Bio-Merieux, Boxtel, Netherlands)] and HCV [Human anti-HCV 3rd generation ELISA (Human Gasellschaft for Bio-chemical and diagnostic MbH, Germany)] were screened at Debre Tabor hospital blood bank. All the blood screening, sample processing and interpretation of test result is performed according to the manufacturer’s instruction. Additionally, data regarding socio-demographic and potential risk factors for HIV, HBV and HCV were collected from each volunteer blood donors using a pre-tested structured questionnaire (questioners in this study, in addition to the routinely used, are modified and designed in a way that assuring collection of relevant associated factors for this study purpose) at the time of blood collection.

Quality control and data analysis
We strictly followed standard operational procedures during sample collection and laboratory investigation in order to maintain the quality of the study. Known positive and negative samples for HIV, HBV and HCV were used as an internal quality control; in addition, all laboratory analysis was performed according to the manufacturers’ instruction. The data were double checked, entered and analyzed using SPSS version 20.0 statistical software. Fishers’ exact test, logistic regression and 95% confidence interval were employed.
for group comparison of blood donors and association of variables. Also, \( p \) value of less than 0.05 was considered as statistically significant.

**Result**

**Demographic characteristics**

A total of 338 voluntary blood donors, as non-remunerated donor found, were identified as blood donors. However, 28 participants were not eligible for blood donation (based on the criteria set by Ethiopian Red Blood Society) hence blood sample from 310 donors were screened for HIV, HBV and HCV at Debre Tabor blood bank from September 2016 to July 2017. Among them 198 (63.8%) were males and 112 (36.2%) were females. The mean ± SD age of the study participants was 23.1 ± 3.02 and 69.0% of the blood donors were from urban areas (Table 1).

**Viral TTIs and associated risk factors among voluntary blood donors**

The proportion of voluntary blood donors with at least one TTI marker was 12.6% while the magnitudes of HIV, HBV and HCV among blood donors were 2.6, 5.8 and 4.2%, respectively. Seropositivity for either of HIV, HBV and HCV is more common in males than females; HIV is more prevalent in 18–27 years younger age groups, whereas both HBV and HCV are prevalent in 28–37 years older age groups (Table 2).

| Variables   | Frequency | Percentage (%) |
|-------------|-----------|----------------|
| Gender      |           |                |
| Male        | 198       | 63.8           |
| Female      | 112       | 36.2           |
| Age (years) |           |                |
| 18–27       | 128       | 41.4           |
| 28–37       | 112       | 36.1           |
| 38–47       | 55        | 17.6           |
| > 48        | 15        | 4.9            |
| Resident    |           |                |
| Urban       | 214       | 69.0           |
| Rural       | 96        | 31.0           |
| Occupation  |           |                |
| Employed    | 143       | 46.1           |
| Day laborer | 19        | 6.1            |
| House wife  | 10        | 3.3            |
| Student     | 132       | 42.4           |
| Others      | 6         | 2.1            |
| Religion    |           |                |
| Orthodox    | 242       | 78.0           |
| Muslim      | 52        | 16.7           |
| Catholic    | 10        | 3.3            |
| Others      | 6         | 2.0            |

Table 1 Sociodemographic status of blood donors at Debretabor General Hospital, South Gondar, Northwest Ethiopia, 2017, N, 310

With respect to the plausible risk factors, the bivariate analysis showed that occupation, history of invasive procedure, history of tattooing, and needle-stick injuries were insignificantly associated with HIV infection. However, multivariate analysis showed that being illiterate and history of having multiple sexual partners was significantly associated with HIV sero-positivity (Table 3).

Regarding on the sero-positivity of HBsAg, neither of having multiple sexual partner, tattooing, needle-stick injury, and ear prickings were significantly associated with HBV infection. But, marital status (being unmarried/single) is significantly associated with HBsAg. The odds of study participants with the history of marital status being single (AOR = 2.01, 95% CI = 0.97–3.78, \( p = 0.023 \)) is around two times higher of acquiring HBV infection that those who were married or couple (Table 4). Higher magnitude of anti-HCV was seen among blood donors next to HBsAg sero-positivity, but all analyzed variables did not show any statistically significant association with respect to seropositivity for HCV. Despite that no risk factor is significantly associated, higher magnitude of HCV sero-positivity was seen among day laborers and donors with multiple sexual partners (Table 5).

**Discussion**

Developing countries, like Ethiopia, are constantly facing insufficient supply of safe blood for transfusion and an increase in the magnitude of TTIs. The WHO encourages blood donation from voluntary donors because this kind of donation believed to have lesser chance harboring and transmitting TTIs [25]. The donor distribution in this study showed a predominantly blood donors aged from 18 to 27 in our donor pool. Studies ([21, 22], and [26]) had reported a similar age distribution among blood donors in Ethiopia. This similarity in age distribution is due to the fact that as it represents the most active age stratum of the population and participates vigorously in blood donation.

This study demonstrated that the overall sero-prevalence of blood-borne viral infections (HIV, HBV and HCV) in the donor population is 12.6%. This finding is somewhat similar with that of studies conducted in Ethiopia and other developing countries [19, 27–29] whereas we found a lower prevalence of TTIs as compared with domestic studies conducted in Ethiopia (29.5 and 43.2%) and other African countries (19.3, 26.2, 28.8%) respectively [18, 30–33]. This is probably because of the actual differences in study population, design, duration, even occupational variation and geographical differences of the study populations; moreover, the prescreening procedure may also play a role for the observed variations. This study further focused on volunteer donors that might decrease the prevalence rates of TTIs from other studies. Additionally, the lower prevalence of TTIs in this study
may be due to the fact that this study is focused only on three viral infections (i.e. HIV, HBV, and HCV), while other studies incorporated magnitude of syphilis in addition to viral infections.

In this study, known that there is a similarity between risk factors and route of transmission between HIV, HBV and HCV, we found that the prevalence of HBV was higher as compared to HCV and HIV. Several studies also come up with similar findings compared with the present study [1, 21, 34–37]. The probable reason for this high prevalence may be due to higher infectivity of HBV compared to HCV and HIV as well as poor awareness of the community towards hepatitis transmission and infection. Although there is a recent advent of Hepatits B vaccination in the country, vaccination is freely accessible for only health professionals while the rest of community members have to pay to get this vaccination. This and the mis-perception towards hepatitis vaccination protective effect may play a significant role for the observed elevated HBV magnitude.

The prevalence of HIV in this study is 2.6% which is lower as compared with 3.8% from Northwest Ethiopia [26], 5.1% Dessie [38], 11.7% Bahir Dar [18] as well as several African studies including 3% reported from Sudan [39], 3.8% in Ghana [40], and 10.6% in Nigeria [41], also lower than 5.5% observed in Maiduguri [42], and 5.3% showed by study conducted at neighbor Kenya [43]. This lower prevalence is may be due to the reason that the above studies were performed on the period where HIV magnitude reached peak and variation in the sensitivity and specificity of screening tools applied in blood bank centers/general population of those countries as well as diagnostic algorithms used in each study. It should be noted that screening algorithms of HIV is frequently changing and modified in several African countries, including Ethiopia, resulting a variable diagnostic performance of test kits that ultimately provide characteristically variable magnitude between countries.

Despite the 2.6% HIV sero-positivity in our study which is lower than from several sub-Saharan Africa countries, where HIV prevalence ranges from 3 to 5% [44], it is much higher than 0.1% Jijiga Ethiopian Somali region [19], a 1.6% magnitude from both Yrgalem and Hawassa studies, South Ethiopia [20, 45] 0.18, 1 and 1.13% reports from Eritrea, Nyala Hospital western Sudan and South Africa respectively [34, 35, 46], 0.4% in Khartoum [47], and from Egypt in which it was no cases reported [48]. The higher report from our study is probably due to the rise in seropositivity of HIV among the general population recently, the highest geographic distributions of HIV infection in the study area which is similar to Ethiopian national data [49]. As well variation in the burden of the disease in the society, population differences regarding social behavior, lifestyle, socioeconomic status, level of awareness and variation in study setting plus a stringent nonstop creation of awareness on HIV in the previously stated study might also explain in-part for the observed variations.

**Table 2** Prevalence of TTIs in different sociodemographic variables among blood donors at Debretabor General Hospital, South Gondar, Northwest Ethiopia, 2017. N, 310

| Variables       | HIV positive N (%) | HBV Positive N (%) | HCV Positive N (%) |
|-----------------|--------------------|--------------------|--------------------|
| Gender          |                    |                    |                    |
| Male            | 6 (3.03)           | 12 (6.06)          | 9 (4.54)           |
| Female          | 2 (1.78)           | 6 (5.35)           | 4 (3.57)           |
| Age (years)     |                    |                    |                    |
| 18–27           | 5 (3.90)           | 6 (4.68)           | 3 (2.34)           |
| 28–37           | 1 (0.78)           | 8 (7.14)           | 7 (6.25)           |
| 38–47           | 1 (1.81)           | 3 (5.45)           | 2 (3.63)           |
| > 48            | 1 (6.66)           | 1 (6.66)           | 1 (6.66)           |
| Resident        |                    |                    |                    |
| Urban           | 6 (2.80)           | 13 (6.07)          | 10 (4.67)          |
| Rural           | 2 (2.08)           | 5 (5.20)           | 3 (3.12)           |
| Occupation      |                    |                    |                    |
| Employed        | 4 (2.06)           | 8 (5.00)           | 4 (2.00)           |
| Day laborer     | 3 (7.69)           | 5 (20.0)           | 5 (20.0)           |
| House wife      | –                  | 1 (10.0)           | 1 (10.0)           |
| Student         | 1 (1.12)           | 4 (3.0)            | 3 (2.20)           |
| Religion        |                    |                    |                    |
| Orthodox        | 7 (2.89)           | 13 (5.37)          | 10 (4.13)          |
| Muslim          | 1 (1.92)           | 4 (7.69)           | 2 (3.84)           |
| Catholic & others | –               | 1 (6.25)           | 1 (6.25)           |
Hepatitis B is one of the most infectious diseases; reaching over 2 billion infected cases worldwide but it is hyperendemic in sub-Saharan Africa and Asia [34] and transmission of hepatitis B or hepatitis C due to contaminated blood is estimated to reach more than 45,000 in Saharan Africa annually [50]. The highest prevalence rates of TTI s among our donors were observed for hepatitis B and C infections than HIV (5.8 and 4.2%, respectively Table 2). This observations, somewhat, agrees with a prevalence of HBV in the Ethiopian general population which was reported to be between 6.1 and 7.4% [51, 52] and similar reports in Ethiopian blood donors as well as other African studies [30, 53, 54]. But our study demonstrated a lower prevalence in comparisons with a study conducted at Bahir Dar 25% [18], Jjiga (10. 9%) [19], Wolaita sodo 9.5% [30], Bale Zone, South East Ethiopia (7.4%) [55], southern Sudan study which was 26% [56] 10% reported at Sudan [57], and Nigerian study [58, 59]. On the other hand our study revealed the highest magnitude of HBV among blood donors than previously reported studies in Ethiopia; Jimma (3.05%), North Gondar (3.6 and 4.7%), Southern Ethiopia (4.2 and 4.8%) [20–22, 26, 45] as well, in Eritrea 4% [34] northern and central Sudan, 5.1 and 5.6% respectively [60, 61]. The high prevalence of HBV as compared with the previous studies might be due to taking into consideration that HBV is highly infectious and transmission is getting elevated recently, variability in study settings and study

**Table 3** Prevalence and multiple logistic regression observations on risk factors associated with HIV infection among blood donors at Debretabor General Hospital, South Gondar, Northwest Ethiopia, 2017, N, 310

| Variables                          | Total | Anti-HIV status | COR (95%CI) | P-value | AOR (95%CI) | P-value |
|-----------------------------------|-------|-----------------|-------------|---------|-------------|---------|
| **Occupation**                    |       |                 | Positive (%)|         |             |         |
| Employed                          | 143   | 4 (2.8)         |             |         |             |         |
| Day laborer                       | 25    | 3 (12.0)        |             |         |             |         |
| House wife                        | 10    | 0               |             |         |             |         |
| Student                           | 132   | 1 (0.8)         |             |         |             |         |
| **Educational status**            |       |                 |             |         |             |         |
| Illiterate                        | 25    | 2 (8.0)         | 1.70 (1.02–2.78) | 0.04 | 1.20(0.40–5.61) | 0.04 |
| Primary school                    | 85    | 1 (1.2)         | 12.1(2.30–25.7) | 0.10 | 15.4(4.30–129) | 0.07 |
| Secondary and above               | 200   | 5 (2.5)         | 1           |         |             |         |
| **Marital status**                |       |                 |             |         |             |         |
| Single                            | 175   | 4 (2.3)         | 1           |         |             |         |
| Married                           | 96    | 1 (1.0)         | 2.10(1.08–3.39) | 0.63 |             |         |
| Widowed                           | 29    | 2 (6.9)         | 4.91(2.11–7.03) | 0.42 |             |         |
| Divorced                          | 10    | 1 (10.0)        | 1.80(0.45–3.99) | 0.07 |             |         |
| **Previous history of BT**        |       |                 |             |         |             |         |
| Yes                               | 60    | 1 (1.7)         | 1.34(0.59–2.33) | 0.41 |             |         |
| No                                | 250   | 7 (2.8)         | 1           |         |             |         |
| **Multiple sexual partner**       |       |                 |             |         |             |         |
| Yes                               | 81    | 7 (8.7)         | 2.44(1.19–4.26) | 0.02 | 1.82(0.91–25.1) | 0.04 |
| No                                | 229   | 1 (0.5)         | 1           |         |             |         |
| **History of invasive procedure** |       |                 |             |         |             |         |
| Yes                               | 12    | 0               |             |         |             |         |
| No                                | 298   | 8 (2.7)         |             |         |             |         |
| **History of tattooing**         |       |                 |             |         |             |         |
| Yes                               | 34    | 2 (5.9)         | 1.22(0.52–2.79) | 0.55 |             |         |
| No                                | 276   | 6 (2.2)         |             |         |             |         |
| **Shaving habit**                 |       |                 |             |         |             |         |
| Yes                               | 49    | 2 (4.1)         | 0.73(0.21–1.77) | 0.65 |             |         |
| No                                | 261   | 6 (2.3)         |             |         |             |         |
| **Needle-stick injury**           |       |                 |             |         |             |         |
| Yes                               | 97    | 3 (3.1)         | 2.11(1.39–3.34) | 0.85 |             |         |
| No                                | 213   | 5 (3.3)         | 1.01(0.30–2.16) | 0.95 |             |         |
| **Communal use of sharp materials** |     |                 |             |         |             |         |
| Yes                               | 123   | 1 (0.8)         | 1.01(0.30–2.16) | 0.95 |             |         |
| No                                | 187   | 7 (3.7)         |             |         |             |         |
| **Sharing of toothbrush**         |       |                 |             |         |             |         |
| Yes                               | 67    | 2 (3.0)         | 1.19(0.72–2.17) | 0.50 |             |         |
| No                                | 243   | 6 (2.5)         | 1           |         |             |         |
| **Ear pricing**                   |       |                 |             |         |             |         |
| Yes                               | 87    | 1(1.1)          | 2.10(0.57–6.87) | 0.23 |             |         |
| No                                | 223   | 7 (3.1)         | 1           |         |             |         |

HIV human immunodeficiency virus, COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval.
period as our study used data collected in 2017 which is by far recent than the above studies.

Global estimation of Hepatitis C Virus (HCV) infection is thought to be over 170 million [62]. In this study 13/310 (4.2%) donors were confirmed positive for HCV infection which is somewhat similar to reports from Southeast Ethiopia 3.6% [63], Adwa 4.3% [64], 3.4 and 4.8% at Sudan and Cameroon respectively [65, 66]. But the result is by far higher than studies conducted in Amhara and Tigray regions 1.7% [17], eastern Ethiopia Jijiga 0.4% [67] and elsewhere 1.1% [68], 0.51% [69], 0.48% [70], 0.21% [71], 0.2% [72], 0.16% [73], and 0.03% [74]. The higher prevalence of this study as compared with the above findings could be supported by the reason that most of the studies were performed earlier at which magnitude of HCV is quite insignificant as well our finding revealed that despite the lower prevalence as compared to HBV, HCV infection is showing an increment in incident among blood donors.

There has been little documentation especially in the study area regarding on the risk factors of viral TTIs among blood donors. This study explains the occurrence of possible risk factors reported by blood donors with positive anti-HIV, HBV and HCV results (Tables 3, 4 and 5). Factors significantly associated with HIV infection were educational status and history of multiple sexual behaviors ($p < 0.045$ and $p < 0.047$ respectively). Conversely, no association was observed between HIV sero-positivity and history of operation, tattooing, shaving habit, needle injury, and other factors. Regarding the donors profile with respect to HBV, sero-positivity for HBsAg was significantly associated with marital status

| Variables                          | Total | HBsAg status Positive (%) | COR (95%CI) | P-value | AOR (95%CI) | P-value |
|------------------------------------|-------|---------------------------|------------|---------|-------------|---------|
| **Occupation**                     |       |                           |            |         |             |         |
| Employed                           | 143   | 8 (5.6)                   | 1.72(0.61–6.96) | 0.35    |             |         |
| Day laborer                        | 25    | 5 (20.0)                  | 1.20(0.42–4.50) | 0.69    |             |         |
| House wife                         | 10    | 1 (10.0)                  | 3.11(0.30–13) | 0.15    |             |         |
| Student                            | 132   | 4 (3.0)                   | 1          |         |             |         |
| **Educational status**             |       |                           |            |         |             |         |
| Illiterate                         | 25    | 2 (8.0)                   | 1.73(0.61–6.75) | 0.35    |             |         |
| Primary school                     | 85    | 4 (4.8)                   | 3.70(1.20–9.03) | 0.45    |             |         |
| Secondary and above                | 200   | 12 (6.0)                  | 1          |         |             |         |
| **Marital status**                 |       |                           |            |         |             |         |
| Single                             | 175   | 7 (4.0)                   | 2.12(1.42–4.59) | 0.01    | 2.01(0.97–3.78) | 0.02    |
| Married                            | 96    | 4 (6.2)                   | 1          |         |             |         |
| Widowed                            | 29    | 4 (13.8)                  | 3.16(0.56–12.4) | 0.19    | 2.45(0.40–5.96) | 0.09    |
| Divorced                           | 10    | 1 (10.0)                  | 0.21(0.30–1.0) | 0.17    | 1.40(0.59–4.57) | 0.79    |
| **Previous history of BT**         |       |                           |            |         |             |         |
| Yes                                | 60    | 2 (3.3)                   | 1.67(1.25–3.92) | 0.63    |             |         |
| No                                 | 250   | 16 (6.4)                  | 1          |         |             |         |
| **Multiple sexual partner**        |       |                           |            |         |             |         |
| Yes                                | 81    | 11 (10.0)                 | 1.02(0.57–2.6) | 0.87    |             |         |
| No                                 | 229   | 7 (3.5)                   | 1          |         |             |         |
| **History of invasive procedure**  |       |                           |            |         |             |         |
| Yes                                | 12    | 1 (8.3)                   | 1.59(0.79–2.99) | 0.11    | 1.25(0.40–5.20) | 0.50    |
| No                                 | 298   | 17 (5.7)                  | 1          |         |             |         |
| **History of tattooing**          |       |                           |            |         |             |         |
| Yes                                | 34    | 3 (8.8)                   | 3.56(1.47–6.19) | 0.45    |             |         |
| No                                 | 276   | 15 (5.4)                  | 1          |         |             |         |
| **Contact with family having liver disease** |       |                           |            |         |             |         |
| Yes                                | 49    | 2 (4.0)                   | 1.48(0.88–2.57) | 0.07    | 1.02(0.01–2.07) | 0.60    |
| No                                 | 261   | 16 (6.1)                  | 1          |         |             |         |
| **Needle-stick injury**            |       |                           |            |         |             |         |
| Yes                                | 97    | 4 (4.1)                   | 1.18(0.68–4.49) | 0.68    |             |         |
| No                                 | 213   | 14 (6.6)                  | 1          |         |             |         |
| **Communal use of sharp materials** |       |                           |            |         |             |         |
| Yes                                | 123   | 3 (2.4)                   | 3.11(0.79–13.7) | 0.14    |             |         |
| No                                 | 187   | 15 (8.0)                  | 1          |         |             |         |
| **Ear pricing**                    |       |                           |            |         |             |         |
| Yes                                | 87    | 2 (2.3)                   | 1.68(0.73–2.51) | 0.24    |             |         |
| No                                 | 223   | 16 (7.2)                  | 1          |         |             |         |

HBsAg hepatitis B surface antigen, COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval
Conclusion
The magnitude of transfusion-transmissible viral infections in blood donated at South Gondar district blood bank is high, known that all donors are voluntary, therefore proper screening of donated blood for HIV, HBsAg and HCV with test methods having better diagnostic performance should be employed which also decreases the rate of undetectable transmission (either due to window period or poor detection of the test) of viral infections. Stringent donor selection, encouragement of blood donation from voluntary donors and creating awareness on the general public regarding HIV, HBsAg and HCV transmission and prevention should be strengthened.

Limitation of the study
This study did not observe the magnitude of TTIs other than HIV, HBV and HCV like syphilis and other infections. Also, the study period and participants are too small that makes generalization based on the observed result very difficult.

Abbreviations
Ab: Antibody; Ag: Antigen; HBsAg: Hepatitis-B surface antigen; HBV: Hepatitis B virus; HCV: Hepatitis C virus; HIV: Human immunodeficiency virus; TTIs: Transfusion-transmissible infections; WHO: Health Organization

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Table 5 Prevalence and multiple logistic regression observations on risk factors associated with HCV among blood donors at Debretabor General Hospital, South Gondar, Northwest Ethiopia, 2017, N, 310

| Variables                        | Total | Anti-HCV status | COR (95%CI) | P-value | AOR (95%CI) | P-value |
|----------------------------------|-------|-----------------|-------------|---------|-------------|---------|
| Occupation                       |       |                 |             |         |             |         |
| Employed                         | 143   | 4 (2.8)         | 0.48 (0.15–3.56) | 0.47    |             |         |
| Day laborer                      | 25    | 5 (20.0)        | 0.70(0.05–5.90)  | 0.87    |             |         |
| House wife                       | 10    | 1 (10.0)        | 2.70(0.93–5.09)  | 0.99    |             |         |
| Student                          | 132   | 3 (2.2)         | 1            |         |             |         |
| Educational status               |       |                 |             |         |             |         |
| Illiterate                       | 25    | 1 (4.0)         | 0.77 (0.18–7.40) | 0.87    |             |         |
| Primary school                   | 85    | 4 (4.7)         | 3.81(0.9–8.60)   | 1.97    |             |         |
| Secondary and above              | 200   | 8 (3.5)         | 1            |         |             |         |
| Marital status                   |       |                 |             |         |             |         |
| Single                           | 175   | 6 (3.4)         | 2.74 (0.61–4.76) | 0.08    | 1.73(0.27–4.90) | 0.17 |
| Married                          | 96    | 3 (3.1)         | 6.74(1.90–21.9)  | 0.04    | 0.26(0.15–2.96) | 0.95 |
| Widowed                          | 29    | 2 (6.9)         | 1.81(68–4.37)    | 0.18    | 0.39(0.11–0.97) | 0.55 |
| Divorced                         | 10    | 1 (10.0)        | 1            |         |             |         |
| Previous history of BT           |       |                 |             |         |             |         |
| Yes                              | 60    | 1 (1.7)         | 1.50 (0.40–4.91) | 0.77    |             |         |
| No                               | 250   | 12 (4.8)        | 1            |         |             |         |
| Multiple sexual partner          |       |                 |             |         |             |         |
| Yes                              | 81    | 9 (11.1)        | 1.32 (0.37–3.96) | 0.10    |             |         |
| No                               | 229   | 4 (1.7)         | 1            |         |             |         |
| History of invasive procedure    |       |                 |             |         |             |         |
| Yes                              | 12    | 0               |              |         |             |         |
| No                               | 298   | 13 (4.4)        | 1            |         |             |         |
| Contact with family having liver disease | Yes | 49    | 3 (8.2)         | 2.22(1.34–4.89) | 0.29    |             |         |
| No                               | 261   | 10 (3.8)        | 1            |         |             |         |
| Needle-stick injury              |       |                 |             |         |             |         |
| Yes                              | 97    | 1 (1.0)         | 1.62(0.45–3.73)  | 0.56    |             |         |
| No                               | 213   | 12 (5.6)        | 1            |         |             |         |
| Communal use of sharp materials  |       |                 |             |         |             |         |
| Yes                              | 123   | 2 (1.6)         | 3.77(1.29–10.21) | 0.77    |             |         |
| No                               | 187   | 11 (5.9)        | 1            |         |             |         |
| Ear pricing                      |       |                 |             |         |             |         |
| Yes                              | 87    | 1 (1.5)         | 2.44(1.23–4.80)  | 0.55    |             |         |
| No                               | 223   | 12 (5.4)        | 1            |         |             |         |

HCV hepatitis C virus, COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval
The authors declare that they have no competing interest.

**Ethics approval and consent to participate**

This study was ethically cleared by the ethics review committee of the School of Biomedical and Laboratory Sciences, University of Gondar and Debretabor hospital. Participation was voluntary and informed verbal consent was obtained from participants prior to inclusion in the study. Initially, participants were briefly explained about the objectives of the study, and on voluntary participation and the right to withdraw at any stage of the study using their local language. Participants were then asked if they understood what has been explained to them. Written consent wasn’t acquired because all the participants were recruited from Debretabor blood bank department where all the participants were donating blood for transfusion. The additional sociodemographic data collection was a non-invasive procedure with no risk associated to it. Therefore, considering all these facts only verbal agreement was acquired to be included in the study. Voluntary blood donors who were diagnosed as positive to either of HIV, HBV, and HCV were immediately linked to the medical outpatient department and voluntary counseling and testing center (VCT) of Debretabor hospital for appropriate treatment and follow up.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no competing interest.

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