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Magnitude and associated factors of syphilis among blood donors in Debre-Berhan Blood Bank, Northeast Ethiopia, 2022.

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Abstract

Background: - Several infectious diseases have been found to be associated with the transfusion of blood and blood components. Reports from studies conducted in many African countries indicate a high incidence of blood-borne pathogens such as syphilis infections among healthy blood donors. The magnitude of syphilis in blood donors in Debre-Berhan is not known. This study was therefore conducted in order to determine the magnitude of syphilis among blood donors that will be seen between the months of May and July 2022. Syphilis accounts for approximately 10% of all commonly sexually transmitted diseases. The risk factors for blood donors infected with syphilis are also risk factors for other blood-borne diseases.

Objective: The study aims to assess the magnitude and associated factors of syphilis among blood donors in the Debre-Berhan Blood Bank, Northeast Ethiopia.

Method: An institution-based cross-sectional study design was conducted and convenient sampling techniques will be employed to take the first 452 blood donors who were eligible for donation based on a NBBS (National Blood Bank Service) questionnaire to determine donor eligibility. Data was collected using a structured self-administered questionnaire. The raw data was entered and cleaned using Epi-data version 3.1, and then exported to SPSS version 20 and analysed using descriptive and inferential statistics. Bi-variable analysis was carried out & variables with a P-value <0.25 were entered into multivariable analysis and variables with a P-value <0.05 in the multivariable analysis were taken as statistically significant.

Result: Among 452 participants, the prevalence of Syphilis infections was 17 (3.8 %).Those blood donors with multiple sexual partner (AOR=4.07; 95% CI: 1.18, 14.06), aged of >32 years (AOR = 3.99; 95% CI: 1.01, 15.70), had no formal education (AOR = 4.01; 95% CI: 1.04, 15.43) and number of donation (AOR = 3.89; 95% CI: 1.08, 13.99) were significantly associated with Syphilis infections.

Conclusion and Recommendation: Factors such as multiple sex partners, age, educational level, and number of donations were significantly associated with syphilis infections. Health consultation and screening of high-risk groups before blood donation need to- be further improved.

NBBS, Regional Health Bureau, and Blood Bank Service focused on blood donation with the ages of 18-24 and 25-31 years, and the majority of these age groups are high school, college, and university students who are thought to be well-informed about these infections.

Also encouragements of blood donation from repeat (regular) blood donors because repeat blood donors know the status of their blood due to post donation counseling after they donate blood.

Keywords: Syphilis, blood donors, Debre-Berhan Ethiopia.

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LIST OF ABBREVIATION AND ACRONYMS

Ab:	Antibody
Ag:	Antigen
AOR:	Adjusted odds ratio
CI:	Confidence interval
ELISA:	Enzyme linked immunosorbent assay
FRD:	Family replacement donors;
HbsAg:	Hepatitis-B surface antigen
HBV:	Hepatitis B virus
HCV:	Hepatitis C virus
HIV:	Human immunodeficiency virus
NBTS:	National blood transfusion service
SPSS:	Statistical package for social services
TTIs:	Transfusion-transmissible infections
VNRBD:	Voluntary Non-Remunerated Blood Donation
WHO:	Health Organization

1. Introduction

1.1 **Background**

Syphilis is a sexually transmitted infection that can cause serious health problems if it is not treated. Syphilis is divided into stages (primary, secondary, latent, and tertiary). There are different signs and symptoms associated with each stage(1). Syphilis is a sexually transmitted illness (STI) caused by the spirochete Treponema pallidum, and it is still a major public health issue in many parts of the world(2). It is carried largely by sexual contact and vertical transmission, with blood transfusion being a rare exception. Because a reliable diagnostic test and effective and affordable treatment options are available, syphilis can be successfully managed through appropriate public health initiatives. However, if syphilis is left untreated, it can lead to devastating fatal outcomes(3).

According to the World Health Organization (WHO), 6 million new syphilitic infections are contracted each year despite the existence of effective preventive and therapeutic measures. In sub-Saharan Africa (SSA), syphilis prevalence in some countries' blood donors may reach 25%(4).

To ensure quality and safety, the World Health Organization recommends screening given blood for at least the major transfusion-transmitted pathogens (TTIs). As a result, HIV, hepatitis B, hepatitis C, and syphilis screening should be required. Up to 500 people acquire TTIs due to contaminated blood transfusion daily in Africa(5).

Treponema pallidum can survive for several years at −78 °C, in the blood from syphilis patients may still be infectious within 4 days storage at − 4 °C. Syphilis and HIV affect similar patient groups and co-infection is common. Infection with syphilis is a risk factor for infection with HIV, HBV, and HCV. The risk factors for blood donors infected with syphilis are also risk factors for other blood borne diseases (6).

1.2 Statement of the problem

In many parts of the world, the incidence and prevalence of syphilis still remains high in both volunteer and family/replacement blood donors. In the literature, there were numerous reports in high-risk groups, both from developed and developing countries, indicating rising prevalence and incidence of syphilis(7).

WHO estimates that 5.6 million new cases of syphilis occurred among adolescents and adults aged 15–49 years worldwide in 2012 with a global incidence rate of 1.5 cases per 1000 females and 1.5 per 1000 males. In 2012, there were 471 000 new cases of syphilis among females, and 466 000 new cases among males in the Region of the Americas. In 2012, there were around 1 million existing cases of syphilis among females, and 992 000 existing cases among males in the Region(8).

The available individual studies showed a wide variation in the prevalence of syphilis among different groups of study population over time and across geographical areas. For instance, syphilis prevalence ranges from 0.1 to 7.5% among blood donors, 1 to 5.1% among pregnant women, and 7.3 to 9.8% among HIV patients (16).

The unprotected transfusion of contaminated blood has grievous health consequences in terms of mortality and morbidity. It also created a significant treatment burden for patients and doctors, while patients became reliant and non-productive. Around 1.5 million transfusions occur annually in Pakistan. The risk of transmission of bloodborne infections could be reduced by careful selection and screening of blood donors (9).

This high prevalence of syphilis has heightened the problems of blood safety in Ethiopia. Also, this high prevalence of syphilis among blood donors was a result of the high discarded rate of the collected blood. Thus, if the collected blood was discarded due to Syphilis infection, there were costs to the economy of the country as well as the institution because there were many materials used to collect and screen the blood, such as blood bags, which are not manufactured in the country, foreign currency, reagents, and human power.

Generally, despite the fact that several studies have been published on the prevalence of Syphilis infections among various risk groups, there is a study limitation about Syphilis prevalence among blood donors that shows healthy blood donors and high-risk group blood donors at the national and institutional levels, which is used for estimating the risk of transfusion and optimizing donor recruitment strategies to minimize blood-borne infectious disease transmission, particularly AIDS. Thus, this study was designed to determine the magnitude of Syphilis infections and its associated factors among blood donors at Debre Berhan Blood Bank.

1.3 Significance of the study

The findings of the study were very helpful to have a deeper understanding of the magnitude of syphilis among blood donors and its associated factors in the country in general. Therefore, this study will generate information on the magnitude of syphilis among blood donors and ascertain any significant factors associated with it. Such information was vital during the development of donor recruitment guidelines by different stakeholders like the Ministry of Health, National Blood Bank Service, and other organizations to take appropriate measures to improve the quality of blood by identifying healthy blood donors in order to prevent the high rate of discarded blood. In addition, blood donors benefited from the findings of this research as well. They were to understand the associated factors of syphilis among blood donors and keep themselves from various related risks and improve their healthy lifestyle.

In addition, it provides baseline information for optimizing donor recruitment strategies and post-donation counselling services to minimize the transmission of infectious diseases. Furthermore, the findings of this research can assist future researchers who are interested in the same area of study.

2. Literature review

A review of the literature on the prevalence of syphilis and its associated factors among blood donors was conducted. It includes socio-demographic, behavioral, and clinical factors.

2.1 Prevalence of Syphilis among blood donors

Syphilis is an infectious disease caused by the spirochete Treponema pallidum. It is a major public health concern, causing genital laceration and possibly facilitating HIV infection acquisition and transmission. Vertical transmission of syphilis may cause miscarriage, stillbirth, prematurity, low birth weight, and death of the baby shortly after birth.

Several studies have been undertaken in various regions of the world to investigate the prevalence and trends of TTIs among blood donors. As a result, each health institution's blood transfusion units should play a key role in screening, monitoring, and controlling TTIs(10).

A study from Pakistan the prevalence of Syphilis among blood donors was 3.91% and the present study indicates that higher prevalence is alarming for blood donors in Pakistan (9).

In China the prevalence of syphilis was 0.88% corresponding to 815 repeatedly reactive ELISA tests out of 92,610 blood donations in 2005 and the rate of TP-positivity was 0.98 in 2017. The prevalence of syphilis in blood donors from 2005 to 2017 in Chengdu also showed an overall upward trend (6).In a study conducted in Brazil shows that the prevalence of Syphilis among blood donors was 0.87%(11). Similar study conducted in Kyrgyzstan in the former Soviet republic located in Central Asia reported that the prevalence of Syphilis among blood donors was 3.3%(12).

Another study conducted in India the prevalence of Syphilis was 0.268%(7).A study contacted in North Darfur Sudan state was 13.0% which is higher than study implemented inKosti- White Nile State-Sudan 6.8%(13). According to a study conducted in Angola, out of a total of 2734 donors, 436 (20%) had positive syphilis serology(14). In Nigeria the prevalence of Syphilis among blood donors was 0.9%(15). A study done in Angola was prevalence rate of 20% was observed for positive syphilis serology, which means the impact of the disease on donors is high(14). In Gabon, the prevalence of syphilis markers was

8.4%(4).Other study in Ghana among blood donors prevalence of Syphilis was 13.5%(16) and in Burkina Faso was 1.5%(17).

A study conducted in Bioko Island, Equatorial Guinea shows that the prevalence of Syphilis among blood donors was 21.51%(18). Another study conducted in Koudougou (Burkina Faso) shows that prevalence of Syphilis among blood donors was 3.96%(19).According to a study, the prevalence of syphilis among blood donors varies. In 2001, a study in Georgia found that 2.3 percent of blood donors had syphilis(10). A study done in in Gash Barka Zonal blood bank, Barentu, Eritrea the prevalence of syphilis among blood donors was 7.2%(11)

A study done in North Darfur State-Sudan the prevalence of syphilis among blood donors was 13.0% which is higher than study implemented in Kostis- White Nile State-Sudan 6.8%(12). Other study in Ghana shows the prevalence of syphilis among blood donors was 2.9%, in Angola 20%(13).A study done in Wolaita-Sodo University Teaching Referral Hospital, South Ethiopia the prevalence of among blood donors was 7.5% which is very high (14).A study conducted in Wolaita Sodo University Teaching Referral Hospital South Ethiopia, the prevalence of Syphilis was 7.5% (20). Similar study conducted in Bahir Dar blood bank the prevalence was 429 (1.2%)(21).

A study conducted in Harer Blood Bank the prevalence of Syphilis among blood donors was 1.1%(10).In a study conducted in Western Oromia among blood donors the prevalence of Syphilis was 0.8%(5). A study conducted in Dire Dawa Blood Bank the prevalence of Syphilis was 3.4%(22).

2.2 Factors Associated with the prevalence of Syphilis

2.2.1 Socio-demographic factors

Different studies suggested that socio demographic factors, such as age, sex, educational status were associated with the prevalence of Syphilis among blood donors. Studies conducted in China by conditional logistic regression, occupation as a risk factor significantly associated with syphilis infection was student, the education was bachelor(6).

In a study conducted in Pakistan the blood donors having higher educational status showed lower prevalence rate of Syphilis (AOR= 12.33, 95% CI= 3.469–43.849). In contrast, the rate of susceptibility to Syphilis was highest (12.50%) among the donors of age range 40-65 years than among those in the age range 25-40 years (5.18%) and 18-25 years (1.95%)(AOR= 7.18,

95% CI= 2.816–18.295)(9). The study conducted in Israel has reported that donors in the age category between 35 and 44 years-old and older than 45 years-old had an increase of 6.5 and 7.4 folds in the prevalence of syphilis, respectively, compared with the younger donors (aged 24 years or less)(23).

According to a study conducted in Burkina Faso to the place of blood collection, as significantly higher prevalence was found in rural areas compared to urban ones among blood donors in Ouagadougou and Fada N´gourma(17). Similar study in Pakistan shows on the basis of residences, blood donors living in rural areas were more prone to Syphilis (4.06%) than those living in urban areas (3.71%). These results were also non-significant (P > 0.05)(9).

According to a study conducted in the Bahir Dar blood bank male blood donors (AOR = 1.3; 1.0, 1.6) donors and the unemployed (AOR = 2.9; 1.4, 6.1) were more likely to have syphilis infection. On the other hand, those blood donors at the age of 25–40 years (AOR = 1.5; 1.1, 2.1) and > 40 years (AOR = 8.2; 5.8, 11.7) were more likely to have syphilis infections compared to those at the age of 18–24 years (21).

2.2.2 Behavioral factors

The study conducted in China revealed that multiple sexual partners were 7.1 times more likely than those who do not have increasing rates of syphilis infections (AOR = 7.1; 95% CI = 3.685, 13.599) and donors that practice tattoos were 3.3 times more likely than donors who do not practice tattoos for increasing rates of syphilis infections (AOR = 3.3; 95% CI = 1.492, 7.167)(6).

In a study conducted in India Syphilis is commonly thought to be a sexually transmitted illness, although shared razors, ear piercings, and tattoos are also high risk factors for infection with syphilis(6). On the other hand, study conducted in China Chengdu the rate of syphilis prevalence in primary blood donors was higher than in repeat blood donors among blood donors from 2005 to 2017(6).

According to a study conducted at Dessie blood bank, the only variable that showed a statistically significant association with syphilis was having multiple sexual behaviors. The odds of syphilis among those who had multiple sexual behaviors were about 7 times higher than among those who had no multiple sex behaviors (AOR = 7.13; CI = 1.4–36.3)(26).

A study conducted in an Eastern Ethiopia blood bank found that individuals exposed to unsafe sex were 2.99 times more likely to have Syphilis than their counterparts (AOR = 2.99; 95% CI: 1.51, 5.92), but chewing tobacco and drinking alcohol had no significant association with Syphilis (22).

2.2.3 Clinical factors

With respect to the association between history of previous blood donation and the prevalence of Syphilis among blood donors, the study conducted in the Honduran Red Cross—Northern Region shows that there is a decreased likelihood of positivity to Syphilis infectious (25).

A study conducted at the Harer blood bank found that replacement blood donors were 70% less likely to be infected with syphilis than voluntary donors (AOR: 0.3; 95%; CI: 1.6, 6.7)(10).

Some of the variables, such as tooth extraction in a study conducted in China, were statistically significant in the univariate analysis (P 0.05), indicating that the variable was a risk factor for syphilis infection (6).

A study conducted in Cameroon revealed that the prevalence of T. Pallidum infection in volunteer blood donors was 2.1% while it was 8.88% among family/replacement blood donors(24). In similar studies conducted in Barentu, Eritrea the prevalence of syphilis among FRBD was significantly higher compared with VNRBD (10.6% vs 2.2%)(23).

Nakuru and Tenwek mission hospitals, Kenya, history of blood transfusion/blood products (P-value = 0.0055), was identified to be a high risk factor independently associated with positive syphilis (25).

2.3 **Conceptual Framework**

A conceptual framework was developed after reviewing relevant literature that describes the relationship between the prevalence of syphilis among blood donors and its associated factors.

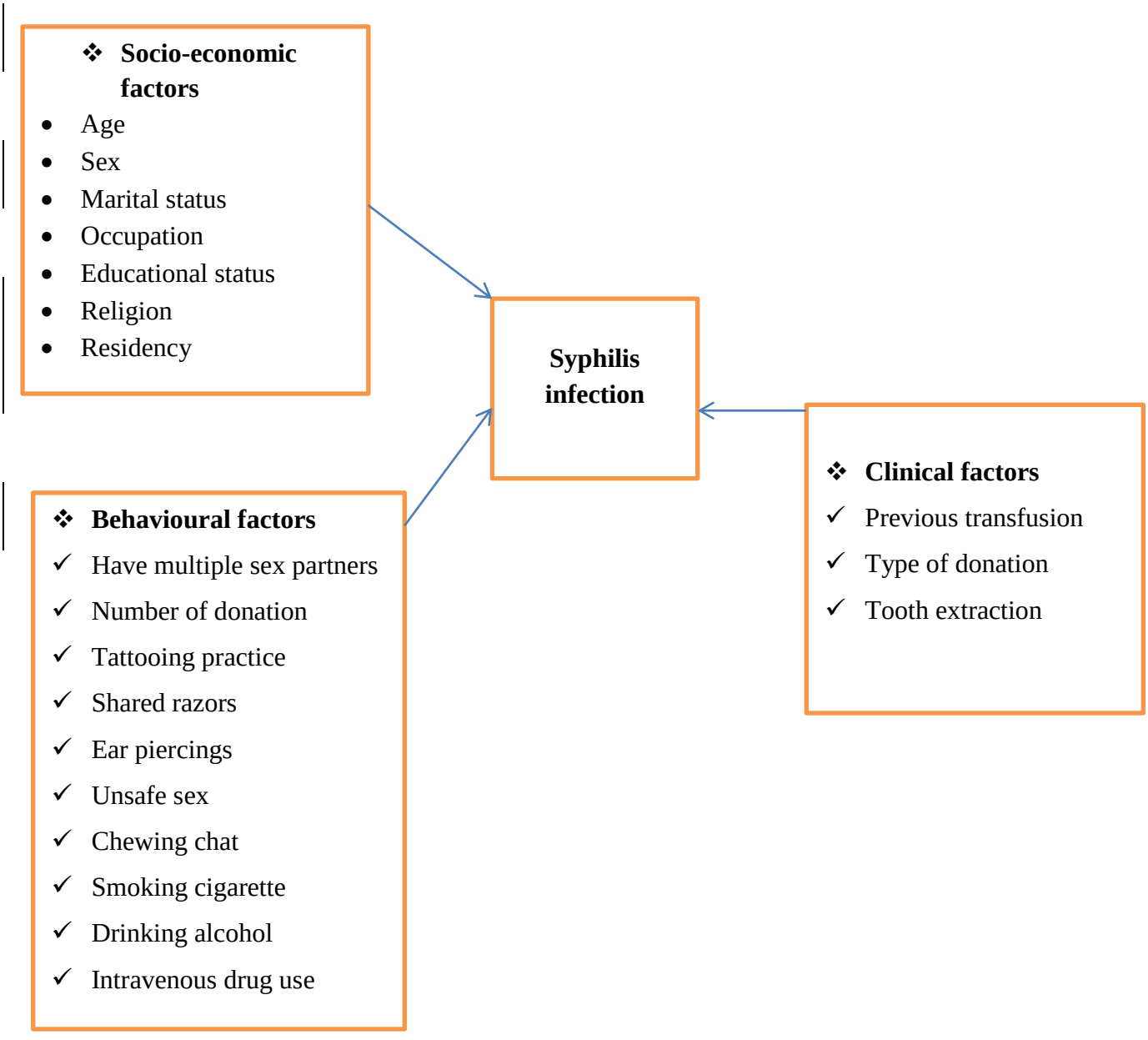

Figure 1:-Conceptual framework developed after reviewing relevant literature ((6),(24) (9))

3. Objective of the study

3.1 General objective

- The study aims to assess the magnitude and associated factors of syphilis among blood donors in Debre-Berhan blood bank Northeast Ethiopia, 2022.

3.2 Specific objectives

- To determine the magnitude of syphilis among blood donors in the Debre-Berhan blood bank in Northeast Ethiopia, 2022.
- Identifying risk factors for syphilis infections among blood donors at the Debre-Berhan blood bank in Northeast Ethiopia, 2022.

4. METHODS

4.1 Study area and period

The study was conducted at Debre-Berhan Blood Bank, which is located in the north Shoa zone. The North Shoa zone is one of the twelve zones found in the Amhara regional state. Its city administration is Debre-Berhan town, which is located 130 km from Addis Ababa and 695 km from Bahir Dar, the capital city of Amhara Regional State. It is bordered on the south and the west by the Oromia region, on the north by Wollo, on the northeast by the Oromia Zone, and on the east by the Afar region. North Shoa has 164 private health centers, 97 governmental health centers, 391 health posts, 8 primary hospitals, 2 general hospitals (of which two are private hospitals), and one comprehensive specialized hospital. The North Shoa zone has 11 public and 2 private hospitals and 1 blood bank. The study's blood bank screens for HIV, HBV, HCV, and syphilis. The blood bank provides services for 11 governmental and 2 private hospitals located in the North Shoa Zone. The blood bank collected 4524 units of blood from voluntary blood donors in 2020/21. The study was conducted from May 24/2022 to July 24, 2022.

4.2 Study Design

An institutional-based cross-sectional study was conducted.

4.3. Population

4.3.1. Source population

The source population was all eligible donors who lived in the North Shoa Zone during the study period.

4.3.2 Study Population

The study population was blood donors who would be eligible to donate blood during the study period.

4.3.3 Study subjects

The study subjects were selected from voluntary blood donors who fulfilled the national and regional blood bank criteria to donate blood.

4.4 **Eligibility criteria**

4.4.1. Inclusion criteria

Those who fulfilled the eligibility criteria were included.

4.4.2 Exclusion criteria

- Blood donor's invisible vein.
- Blood donors are unable to finish blood donations.
- Donors who refuse after being screened**.**

4.5 Sample size determination

With a 95% level of confidence, a 2.5% margin of error, and a 10% nonresponse rate, sample size was determined using a single population proportion formula considering the 7.2% prevalence of Syphilis infection in Gash Barka Zonal Blood Bank, Barentu, Eritrea, (11) as follows?

$$n = \frac{[(Za/2)2\ P\ (1-P)]}{d2}$$

Where, n= initial sample size

Z= 1.96 the corresponding Z-score for the 95% CI

P= Proportion= 7.2% =0.072

d= Marginal error = 2.5%= 0.025

$$n= \frac{(1.96)2x0.072\ (1-0.072)}{(0.025)2} = 411$$

n=452 including the 10% non-respondent

4.6 Sampling procedure

All donors were prospectively recruited in the study and convenient sampling techniques were employed to take the first 452 blood donors who were eligible for donation based on a NBBS (National Blood Bank Service) questionnaire to determine donor eligibility.

4.7 Study variable

4.7.1. Dependent variable

The dependent variable is syphilis infection (yes/no).

4.7.2 Independent variable

The independent variables include:

- Socio-demographic factors
    - ✓ Age
    - ✓ Sex
    - ✓ Marital status
    - ✓ Occupation
    - ✓ Educational status
    - ✓ Religion
    - ✓ Monthly income
    - ✓ Residency
- Behavioral factors
    - ✓ Have multiple sex partners
    - ✓ Number of donation
    - ✓ Tattooing practice
    - ✓ Shared razors
    - ✓ Ear piercings
    - ✓ Unsafe sex
    - ✓ Chewing chat
    - ✓ Cigarette smoking

- ✓ Alcohol drinking
- ✓ Intravenous drug use

❖ Clinical factors

- ✓ Previous transfusion
- ✓ Type of donation
- ✓ Tooth extraction

4.8. Operational Definitions

- **Number of donation:-**how many times did the donor donate blood previously.
- **Type of donation :-**by which means of donors donate blood (Voluntary Non-Remunerated Blood Donation, Family/replacement or commercial/paid donations)
- **Voluntary donors**: donor gives blood of his or her own free will and receives no payment, either in the form of cash or in kind(26).
- **Replacement donors**: donors of blood who replace blood used by their relatives or friends from blood bank stocks(26).
- **Mobile donors**: a donors who gave blood only once during blood donation campaign made at people gathering in school, in community or other institution for their own activities(26).
- **Transfusion Transmitted Infections (TTI):** infectious agents including HBV, HIV, HCV and Syphilis(26).
- **Eligibility criteria for blood donation:-** Age 18-65 years, Weight; at least 45 Kg, Blood pressure systolic 100-149 mmHg and diastolic 70-89 mmHg, Hemoglobin 12.5 g/dl for females and 13.5 g/dl for males, Frequency of donation: For whole blood donors 12 weeks, Fluid intake and food; donors should maintain their usual food and fluid intake, Pregnancy, lactation and menstruation: Donors defer during pregnancy and up to 1 year after delivery and Donor's medical history: assessed and free of Non-communicable disease and for Medical and surgical interventions.(27)
- **Current smoker**: An adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes(28).
- **Heavy alcohol drinker:** For men, consuming more than 4 drinks on any day or more than 14 drinks per week and or women, consuming more than 3 drinks on any day or more than 7 drinks per week(29).

- **Current khat chewer:-** is an individual who had used khat at least once in the last month before the study(30).
- **Syphilis infection**: having the diagnosis of syphilis infection by using the 4th generation Enzyme-Linked Immune Sorbent Assay (ELISA) test kit by senior laboratory professionals in the blood bank? If confirmed "+ve" from the test.

4.9. Data collection tool and procedure

Prior to blood collection, the donors were requested to answer a questionnaire to determine whether they were eligible for donation per the criteria set by the National Blood Bank Service (NBBS) and by the study area blood bank. A pre-tested structured data collection tool was prepared for both independent and dependent variables. Two trained and oriented blood bank workers were collecting the data.

Data was collected by a structured questionnaire developed from previous different literature and it was numbered to identify those who would respond and/or not ((6), (30), (29), (28)).

After donors agreed to take part in the study, he or she signed a consent form, and data collectors collected baseline information from each participant. Then, the blood sample was taken from the blood bags of donated blood to sterile test tubes for further use and for screening with a closed system. Then the collected blood was centrifuged at 3000 revolutions per minute (RPM) for at least 20 minutes at room temperature and the serum was separated and stored at 2 to 8°C until it was tested. Samples were brought to room temperature before testing. The serum sample was performed and analyzed for Syphilis using the 4th generation Enzyme-Linked Immune Sorbent Assay (ELISA) test kit by a senior laboratory professional in the blood bank.

4.10. Data quality assurance

The questionnaire was prepared in English and translated back to Amharic, then translated back to English to ensure consistency of the questions. Pre-testing of 5% of the questionnaire was done prior to the study among blood donors to identify errors and modify them. To check the clarity and consistency of the questionnaire, its Cronbach alpha was checked. The clarity, understandability, and flow of each question and the time to fill out the questionnaire were

assessed and found satisfactory. Daily, all the collected data was checked for completeness by the principal investigator. Quality control of serological tests, known positive and negative controls, will run in parallel with test samples.

All laboratory procedures were carried out following standard operating procedures (SOPs). The quality assurances of pre-analytical, analytical, and post-analytical stages will be applied.

Pre-analytical stage

Blood samples were collected aseptically from blood donors and properly labeled with the donor identification number. Trained laboratory personnel collected the specimen. The samples will be centrifuged; the serum will be evaluated and separated appropriately and stored until transported to the laboratory. The transported samples were stored at the optimum temperature until they were processed.

Analytical stage

Trained laboratory personnel in the Hema diagnosis laboratory will perform the test with the Huma reader and washer (Human, Germany). The reagents and the test method were assessed with known positive and negative control materials. The standard laboratory procedures will also be followed, and the supervisors will check the results.

Post-analytical stage

The results were recorded with the donors' identification number. In order to avoid errors in the results of the test, they were repeatedly checked before reporting.

4.11. Data processing and analysis

The data entry and cleaning were carried out using Epi-data version 3.1, and then exported to SPSS version 20 for analysis. Descriptive statistics were computed to determine the frequencies and percentages of the dependent and independent variables. An odds ratio with a 95% confidence interval was computed to assess the presence and degree of association between the dependent and independent variables. Bivariate analysis was done to evaluate the associations of each independent variable with the dependent variables. Variables with a p-value <0.25 in the bivariate analyses were entered into multiple logistic regression models to identify independent predictors of syphilis infections. To assess the existence of correlation among predictor variables, a multicollinearity test was performed Hosmer and Lemeshow

goodness of fit to the final model was also checked and was found to be fit. The strength of the association between the predictor variable and outcome variables was assessed by using adjusted odds ratios along with 95% confidence intervals. A P-value of < 0.05 was declared as statistically significant. Finally, the data was presented using statements, tables, and figures.

4.12. Ethical Consideration

The study was conducted after obtaining ethical clearance from Debre-Berhan University's Asrat Woldeyes Health Science Campus Department of Public Health. A formal letter, from the Arat Woldeyes health science Campus of Debre-Berhan University, was submitted to the blood bank to obtain their co-operation. The respondents' rights and dignity were also respected. Informed oral consent was obtained from the study participant to confirm willingness for participation after explaining the objective of the study. The respondents were notified that they had the right to refuse or terminate the interview at any point. The information provided by each respondent was kept confidential throughout the research process.

4.13. Dissemination of Results

The finding of this study primarily was submitted to Debre-Berhan University, Asrat Woldeyes Health Science Campus Department of public health as part of Masters of public health in Epidemiology thesis. In addition, it will also be disseminated to Debre-Berhan Blood Bank and respective stakeholders. Besides, the study findings was considered to present and publish on local & international conferences and peer reviewed journal or report for public and private health institutions those who are interested on the topic.

5. RESULT

5.1 Socio- Demographic Characteristics of Respondents

A total of 452 blood donors were enrolled in this study which is 100%. In total, 268 (59.3%) of the study participants were male, and 240 (53.1%) of the donors belonged to the age group of 18–24 years. The mean (standard deviation) age of participants was 25.48 (7.158) years. Of the total, 434 (96%) donors were urban and the rest were rural residents.

Regarding the occupational status of the participants, about 236 (52.2%) were students, and government staff numbered 96 (21.2%). The majority of 200(44.2%) of the study participants had a complete primary and secondary level of educational status, the rest 196 (43.4%) and 56(12.4%) had college or above and no formal educational status, respectively (Table 1).

Table 1 Socio-demographic characteristics of blood donors in Debre-Berhan Blood Bank, 2022 (n = 452).

Characteristics	Response	frequency	percentage
Age	18-24 years	240	53.1
	25-31 years	101	22.3
	>32 years	111	24.6
Gender	Male	268	59.3
	Female	184	40.7
Marital Status	Married	106	23.5
	Unmarried	346	76.5
Religion	Orthodox	448	99.2
	Muslim	2	0.4
	Protestant	2	0.4
Residence	Urban	434	96.0
	Rural	18	4.0
Educational Level	No formal education	56	12.4
blood donors	Primary &secondary	200	44.2
	College & above	196	43.4
	Student	236	52.2
Occupation of blood	Unemployed	36	8.0
donor	Private Worker	76	16.8
	Gov't Staff	96	21.2
	Military or Police	3	0.7
	Farmer	5	1.1

5.2 Behavioral Characteristics of Respondents

Out of the total participants, 53 (11.7%), 38 (8.4%), and 101 (22.3%) were ear pierced, alcohol users, or had tattoos, respectively. Of the participants, 43 (9.5%) and 23 (5.1%) had multiple sexual partners and had a practice of unprotected sex, respectively. From the total participants, 220 (48.7%) and 232 (51.3%) were repeat donors and first-time donors, respectively (Table 2).

Table 2 Behavioural characteristics of blood donors in in Debre-Berhan Blood Bank, 2022 (n = 452).

Characteristics	Response	Frequency	Percentage
Multiple sex	Yes	43	9.5
Partner	No	409	90.5
Practicing unprotected	Yes	23	5.1
sex	No	429	94.9
Had tattoo	Yes	101	22.3
	No	351	77.7
Had ear pierced	Yes	53	11.7
	No	399	88.3
Sharing sharp	Yes	2	0.4
Material	No	450	99.6
Smoking Cigarette	Yes	6	1.3
	No	446	98.7
Chewing Chat	Yes	1	0.2
	No	451	99.8
Drinking Alcohol	Yes	38	8.4
	No	414	91.6
Use intravenous drug	Yes	1	.2
	No	451	99.8
Number of donation	First	232	51.3
	Repeat	220	48.7

5.3 Clinical characteristics of Respondents

Among the study participants, 6(1.3%) and 87(19.2%) had a history of blood transfusions and dental procedures, respectively (Table 3).

Table 3 Clinical characteristics of blood donors in Debre-Berhan Blood Bank, 2022 (n = 452).

Characteristics	Response	Frequency	Percentage
Dental procedures	Yes	85	18.8
	No	367	81.2
Blood transfusion	Yes	6	1.3
	No	446	98.7

5.4 Prevalence of Syphilis

The overall prevalence of syphilis among blood donors who participated in this study was 17 (3.8%) and the positivity was higher in male participants at 14 (5.2%).

The prevalence of syphilis was higher among blood donors aged greater than 32 years. The highest occupation-specific prevalence of syphilis was observed among private workers (10.5%) and the lowest prevalence was seen among students (1.7%).

5.5 Factors associated with Syphilis

Bivariable analysis was done to test whether an association was present or not between Syphilis infection and independent variables. It helps to identify candidate variables for multivariable logistic regression. Based on the analysis, variables such as age group, gender, educational level, multiple sex partners, previous history of blood donation, tattooing, tooth extraction, and alcohol drinking were associated with Syphilis infections (p 0.25).

Multivariable logistic regression was also done to test for the presence of a significant association between the prevalence of Syphilis infections and those factors which had an association during the bivariable logistic regression so as to control the effect of confounding variables and determine the main factors that contribute to the prevalence of Syphilis infections. Even though many variables are significantly associated with syphilis infections at

a bivariable level, the variables having a significant association at a multivariable level were age, educational level, multiple sexual partners, and number of blood donations (Table 5).

During multivariable analysis, blood donors over the age of 32 were 3.99 times more likely to be infected with Syphilis than those between the ages of 18 and 24 (AOR = 3.99; 95% CI: 1.01, 15.70). Individuals who had exposure to multiple sexual partners were 4.07 times more likely to be associated with syphilis infections compared to their counterparts (AOR = 4.07; 95% CI: 1.18, 14.06). Blood donors with no formal education were 4.01 times more likely than their counterparts to be infected with Syphilis (AOR = 4.01; 95% CI: 1.04, 15.43). First-time blood donors had a 3.89-fold higher risk of Syphilis than repeat donors (AOR = 3.89; 95% CI: 1.08, 13.99) (Table 4).

Table 4 Multivariable analysis of factors associated with Syphilis among blood donors in Eastern Ethiopia, 2022 (n = 452).

Variables	Response	Overall prevalence of TTIS		COR(95% CI)	AOR(95% CI)	P-value
		Positive (%)	**Negative (%)**			
Age	18-24	4 (1.7)	236 (98.3)	1	1	
	25-31	5 (5.0)	96 (95.0)	3.07(0.8-11.69)	1.86(0.44-7.89)	0.400
	>32	8 (7.2)	103 (92.8)	4.58(1.35-15.6)	3.99(1.01-15.7)	**0.048***
Gender	Male	14 (5.2)	254 (94.8)	3.33(0.94-11.7)	1.54(0.36-6.67)	0.56
	Female	3 (1.6)	181 (98.4)	1	1	
Educational	No formal education	7 (12.5)	49 (87.5)	1	1	
Level	Primary& Secondary	5 (2.5)	195 (97.5)	5.46(1.66-17.9)	4.01(1.04-15.43)	**0.44***
	College & above	5 (2.6)	191 (97.4)	0.98 (0.28-2.4)	1.51(0.38-5.94)	0.56
Multiple sex	Yes	6 (14.0)	37 (86.0)	5.87(2.1-16.77)	4.07(1.18-14.06)	**0.027***
Partner	No	11 (2.7)	398 (97.3)	1	1	0.377
Drinking Alcohol	Yes	4 (10.5)	34 (89.5)	3.63(1.12-11.7)	1.41(0.35-5.72)	
	No	13 (3.1)	401 (96.9)	1	1	
Number of	Repeat	4 (1.2)	216 (98.2)	1	1	
donation	First	13 (5.6)	219 (94.4)	3.21(1.03-9.97)	3.89(1.08-13.99)	**0.038***
Tattooing	Yes	7 (6.9)	94 (93.1)	2.54(0.94-6.85)	3.06 (0.90-10.08)	0.073
	No	10 (2.8)	341 (97.2)	1	1	
Tooth extraction	Yes	6 (5.8)	79 (97.2)	2.46(0.88-6.68)	2.50(0.75-8.37)	0.137
	No	11 (3.0)	356 (97.0)	1	1	

6. DISCUSSION

This study attempted to determine the prevalence of Syphilis infections and its associated factors among blood donors in the Debre-Berhan blood bank. Syphilis was significantly associated with age, multiple sex partners, educational level, and number of donations.

The overall prevalence of syphilis infection among the study participants was 3.8 % (95% CI: 2.2, 5.5). This finding is similar to studies conducted in Eastern , Ethiopia 3.4% (31), Burkina Faso 3.96%(19). On the other hand, this finding is lower than the previous study conducted in Wolaita Sodo, Ethiopia 7.9% (10) Cameroon 8.1%(32) and Tanzania 6.4%(33). The discrepancies might be due to the inclusion of differences in blood donors' types, differences in population risks or effectiveness, stringent procedures of donor screening and genetic diversity, or socio-cultural conditions may be possible factors. On the other hand, variations in the total sample size, the nature of the study population, the research method used, the time period, the test kits on the market, storage, donor type, and test kit validation could be the cause of the discrepancy in the total prevalence of Syphilis infection between various studies.

In this study, those blood donors at the age greater than 32 years (AOR = 3.99; 95% CI: 1.01-15.70) were more likely to have Syphilis infection compared to those at the age of 18–24 years, which was significantly associated with Syphilis infection. This finding is consistent with studies conducted in Bahir Dare (21) and Eastern Ethiopia (31). This might be due to the fact that most blood donors in our study were between the ages of 18–24 years old, high school and university students, whom they considered to have good awareness regarding this infection.

This study showed that syphilis infection was 4.01 times higher among blood donors with no formal education compared to their counterparts. This finding is comparable with the study done in Eastern Ethiopia(31) and Kenya(34). This might be attributed to the fact that as the level of education increases, there is a high probability of being aware of preventive measures against Syphilis infection. In addition, it is likely that those with a high education understand the criteria for self-deferral better. Some studies suggest that better educational attainment may correlate with a lower risk of infection among blood donors.

This study showed that multiple sexual partners were significantly associated with syphilis infection. This finding is consistent with studies conducted in Eastern Ethiopia (31), China (35) and Kenya(36). The key mode of acquiring sexual transmitted infection in Africa is sexual activity, multiple partners being one of the main risk factors.

The current study also showed that those blood donors who donated blood for the first time or new blood donors (AOR = 3.89; 95% CI: 1.08–13.99) were more likely to have Syphilis infection compared to those regular (repeat) types of blood donors. Similar findings have been reported from Bahir Dar (21) and Kenya study (36). This might be directly associated with the post-donation counseling service. There are individuals who have wrong perceptions of donating blood as a method of knowing their own status regarding TTIs and continuing their life as normal if they are not informed that this will in turn increase the transmission of TTIs among the general population by one or other means.

7. Conclusion

The magnitude of syphilis was 3.8% (95%; CI: 2.2, 5.5). Syphilis was significantly associated with age, multiple sex partners, educational level, and number of donations.

As we have seen in the multivariable analysis, when age increases, the prevalence of syphilis infection also increases, and when educational level increases, the prevalence of syphilis infection reduces. First-time donors and multiple sexual partners also increase the prevalence of syphilis infection. Therefore, strict adherence with the criteria of preliminary blood donor selection should be implemented to reduce the amount of blood being withdrawn from transfusion after collection and screening related to blood donors' age and educational level. It is also important to increase the number of repeated voluntary donors through promotion of blood bank activity. Health consultation and screening of high-risk groups before blood donation need to be further improved.

8. Recommendations

- NBBS, Regional Health Bureau, and Blood Bank Service focused on blood donation with the ages of 18-24 and 25-31 years, and the majority of these age groups are high school, college, and university students who are thought to be well-informed about these infections.
- NBBS should be included in the screening criteria regarding educational level because when the level of education increases, there is a high probability of being aware of preventive measures against these infections. In addition, it is likely that those with a high education understand the criteria for self-deferral better. Some studies suggest that better educational attainment may correlate with a lower risk of infection among blood donors.
- Regarding multiple sexual partners, NBBS also revised the blood donation screening guideline. That means blood donors that have multiple sexual partners will be placed in the deferral categories.
- Also, encouragements of blood donation from repeat (regular) blood donors because repeat blood donors know the status of their blood due to post-donation counselling after they donate blood.

9. Strength and Limitations

Limitations

This study has some limitations:-

- Self-reported behavioral factors may introduce social desirability bias..
- The method of laboratory analysis does not include molecular analysis, which is a more confirmatory test.
- The question of sex lifestyle is associated with stigma, and it may have an impact on the overall risk estimate.

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Debre Birhan University

Asrat Woledeys Health Science Campus

Department of Public Health

Appendix

Annex I: Informed Consent Form

Dear participants (blood donors)

Hello! My name is _____ I am a data collector temporarily working on behave of principal investigator on the thesis with the topic assess the magnitude of Syphilis and associated factors among blood donors in north Shoa Debre Birhan blood bank. This study may help policymakers, ministry of health, Amhara regional health bureau, stakeholders, and significant others to take actions based on the findings. The study will involve socio-demographic, behavioral and clinical factors questions, and your magnitude of Syphilis will be measure by those questions. To effectively attain the objective of the research, I am requesting your help. Your participation is voluntary and your name will not be written in this form and will never be used in connection with any information you tell us. Your responses will be completely confidential. It is your full right to refuse in responding to any question or all of the questions. If you don't want to participate you can leave the questionnaire empty. However, your honest answers to these questions will help me in better understanding about the magnitude of Syphilis and associated factors, so; it will take a maximum of 15 minutes to answer these questions.

However, in order to attain its goal, I kindly request your kind and good will to participate in the survey. So, please take a few minutes to answer the questions.

Would you like to participate? Yes (___) No (___). Mark" X" in the appropriate space

If yes, go to the next page. If no, remain on your seat. If you have any question, or concern please do not hesitate to contact the principal investigator using the following address!

Principal investigator name: **Temesgen Belayneh**, Contact phone number 0911583875/13986909

Appendix 2: Questionnaire English version.

Part I: Please circle the chosen option(s) or write the appropriate answer in the space provided.

Part I: socio-demographic characteristics

	Participants code……	Date----------	

S.NO	Variables	Categories	Remark
101	How old are you?	(----------)in year	
102	Sex	1.male 2.female	
103	Educational level	1.< Primary school 2.Middle school 3.High school 4. Complete university 5. Postgraduate	
104	What is your marital status?	1= Single 2= Married 3= divorced 4 = widow/widower	
105	Occupation	1. Student 2.Unemployed 3.Private Worker 4.Government staff 5.Military or police 6. Farmer 7.Other Specify---------	
106	Religion	1.Orthodox 2.Muslim 3.Perotestan 4.Other	
107	How much is your total Monthly family income?	1.----------ETB	

108	Place of residency	1.Urban 2.Rular	

Section II Behavioral factors.

Instruction-Please read the following questions carefully and encircle on the correct answer option.

S.NO	Question	Response	Remark
201	Do you have more than one sexual partner?	1.Yes 2. No	
202	Do you have history of blood donation?	1.Yes 2.No	
203	If yes how many times?	1.First times 2.More than 2 times	
204	Did you have tattoo?	1.Yes 2. No	
205	Have you ever had ear pierced?	1.Yes 2. No	
206	Have you ever had shared razors	1.Yes 2. No	
207	Did you have practicing unsafe sex?	1.Yes 2. No.	
208	Have you currently smoke cigarette?	1.Yes 2.No	
209	Did you used khat at least once in the last month before the study?	1.Yes 2.No	
210	Did you consume more than 3 drinks on any day or more than 7 drinks per week?	1.Yes 2.No	
211	Intravenous drug use ?	1.Yes 2.No	

Section III- Clinical factors

Instruction-Please read the following questions carefully and encircle on the correct answer option.

S.NO	Variables	Categories	Remark
301	History of blood transfusion?	1.Yes 2. No	
302	If "Yes" to Q 1, how many times?	1.First time 2. Multiple times	
303	Have you ever extracted teeth, or filled teeth?	1.Yes 2. No	
304	Have you ever donated blood?	1.Yes 2. No	
305	If "Yes" to Q 4, by which type of method did you have donated blood?	1.Voluntarily with the blood bank 2.For replacement/family 3.For paid/commercial	

የደብረ ብርሃን ዩኒቨርሲቲ

አስራት ወልደየስ ጤና ሳይንስ ግቢ

የሕብረተሰብ ጤና ትምህርት ክፍል

አባሪ ፡ በመረጃ የተደገፈ የስምምነት ቅጽ

ውድ ተሳታፊዎች (ደም ለጋሾች)

ሰላም! ስሜ _____ በሰሜን ሸዋ ደብረ ብርሃን ደም ባንክ ደም ለጋሾች መካከል ያለውን የቂጥኝ መጠን እና ተያያዥ ጉዳዮችን በመገምገም በርዕሰ ጉዳዩ ላይ የርእሰ መርማሪ ባህሪን በጊዜያዊነት መረጃ ሰብሳቢ ነኝ። ይህ ጥናት ፖሊሲ አውጪዎች፣ የጤና ጥበቃ ሚኒስቴር፣ የአማራ ክልል

ጤና ጥበቃ ቢሮ፣ ባለድርሻ አካላት እና ሌሎች ጉልህ አካላት በግኙቱ ላይ ተመስርተው እርምጃ እንዲወስዱ ሊረዳቸው ይችላል። ጥናቱ የሶሺዮ-ስነ-ሕዝብ፣ የባህሪ እና ክሊኒካዊ ጉዳዮች ጥያቄዎችን ያካትታል፣ እና የቁጥጎዎ መጠን የሚለካው በእነዚያ ጥያቄዎች ነው። የጥናቱን ዓላማ በብቃት ለመድረስ፣ የእርስዎን እገዛ እጠይቃለሁ። የእርስዎ ተሳትፎ በፈቃደኝነት ነው እና የእርስዎ ስም በዚህ ቅጽ ውስጥ አይጻፍም እና እርስዎ ከሚነግሩን ማንኛውም መረጃ ጋር በተያያዘ ፈጽሞ ጥቅም ላይ አይውሉም. የእርስዎ ምላሾች ሙሉ በሙሉ ሚስጥራዊ ይሆናሉ። ለማንኛውም ጥያቄ ወይም ሁሉንም ጥያቄዎች ለመመለስ እምቢ ማለት ሙሉ መብትህ ነው። መሳተፍ ካልፈለጉ መጠይቁን ባዶ መተው ይችላሉ። ይሁን እንጂ ለእነዚህ ጥያቄዎች የሰጠኸው ትክክለኛ መልስ ስለ ቂጥኝ መጠን እና ተያያዥ ምክንያቶች የበለጠ እንድረዳ ይረዳኛል፣ ስለዚህ; ለእነዚህ ጥያቄዎች መልስ ለመስጠት ቢበዛ 15 ደቂቃ ይወስዳል።

ሆኖም፣ ግቡን ለማሳካት፣ በዳሰሳ ጥናቱ ላይ ለመሳተፍ በጎ ፈቃድዎን በአክብሮት እጠይቃለሁ። ስለዚህ፣ እባክዎን ለጥያቄዎቹ መልስ ለመስጠት ጥቂት ደቂቃዎችን ይውሰዱ። መሳተፍ ይፈልጋሉ? አዎ አይ (___). "X" በተገቢው ቦታ ላይ ምልክት ያድርጉ አዎ ከሆነ ወደሚቀጥለው ገጽ ይሂዱ። ካልሆነ፣ በመቀመጫዎ ላይ ይቆዩ። ማንኛውም አይነት ጥያቄ ወይም ስጋት ካለዎት እባክዎን በሚከተለው አድራሻ ዋናውን መርማሪ ለማነጋገር አያመንቱ! የዋናው መርማሪ ስም፡- ተመስገን በላይነህ፣ ስልክ ቁጥር 0911583875/13986909

አባሪ 2፡ መጠይቅ በአማረኛ።

እባክህ የተመረጠውን አማራጭ(ዎች) አክብብ ወይም ተገቢውን መልስ በተዘጋጀው ቦታ ጻፍ።

ክፍል አንድ፡- ማህበረ-ሕዝብ ባህሪያት

ተ.ቁ	ጥያቄዎች	መልስ	ወደ ይሻገሩ
101	እደሜ	.....አመት	
102	ፆታ	1. ወንድ 2. ሴት	
103	የጋብቻ ሁኔታ	1. ያገባ/ች 2. ያላገባ/ች 3. የፈታ/ች	
104	የትምህርት ሁኔታ	1. ያልተማረ 2. የመጀመሪያደረጃ ት/ቤት 3. ሁለተኛ ደረጃ ት/ቤት 4. ዲኘሎማና ከዚያ በላይ	
105	የስራ ሁኔታ	1. ተማሪ 2. የመንግስት ሰራተኛ 3. የግል ሰራተኛ 4. ፓሊስ ወይም ወታደር 5. ገበሬ 6. ሌላ----------	
106	ሀይማኖት	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ሌላ	
107	የገቢ መጠን	1.----------ብር	
108	የመኖሪያ ቦታ	1. ከተማ 2. ገጠር	

ክፍል 2፤የባህሪ ምክንያቶች

ተ.ቁ	ጥያቄዎች	መልስ	ወደ ይሻገሩ
201	ከዚህ በፊት ደም ለማሰዉ ያቃሉ?	1.አዎ 2. የለም	
202	መልሰዎ “አዎ” ከሆነ ለስንት ጊዜ?	1. ለመጀመሪያ ጊዜ 2. ሁለትና ከዚያ በላይ	
203	ከአንድ በላይ የፍቅር ጓደኛ አለህ?	1.አዎ 2. የለም	
204	ንቅሳት ተነቀሰዋል?	1.አዎ 2.የለም	
205	የጀሮዎትን ተበስተዉ ያቃሉ?	1.አዎ 2.የለም	
206	ምላጭ ተጋርተዉ ያቃሉ?	1.አዎ 2.የለም	
207	ደህንነቱ ያልተጠበቀ የግብረ ስጋ ግንኙነት ፈፅመዉ ያቃሉ?	1.አዎ 2.የለም	
208	በአሁኑ ጊዜሲጋራ ታጨሰሃል?	1.አዎ 2.የለም	
209	ከጥናቱ በፊት ባለፈው ወር ቢያንስ አንድ ጊዜ ጫት ተጠቀምክ?	1.አዎ 2..የለም	
210	በማንኛውም ቀን ከ 3 በላይ መጠጦች ወይም በሳምንት ከ 7 በላይ መጠጦች ወስደዋል?	1.አዎ 2.የለም	
211	በደም ስር የሚሰጥ መድሀኒት ይጠቀማሉ(ከህክምና ዉጭ)?	1.አዎ 2.የለም	

ክፍል ሶስት፡-ክሊኒካዊ ምክንያቶች

ተ.ቁ	ጥያቄዎች	መልስ	ወደሚቀጥለዉ ይሻገሩ
301	ደም ወስደዉ (ተለግሰዉ) ያቃሉ?	1.አዎ 2.የለም	
302	መልስዎ “አዎ” ከሆነ ለስንት ጊዜ?	1.ለመጀመሪያ ጊዜ 2.ሁለትና ከዚያ በላይ	
303	ጥርስ አስወልቀዉ(አስሞልተዉ) ያቃሉ?	1.አዎ 2.የለም	
304	ከዚህ በፊት ደም ለማሰዉ ያቃሉ?	1.አዎ 2.የለም	
305	መልስዎ “አዎ” ከሆነ በየትኛዉ መንገድ?	1.በደም ባንክ በፈቃደኝነት 2.ለቤተሰብ ትክ 3.በክፍያ	

11.3 Annex III: Declaration

I, the undersigned, hereby declare that the work entitled ''Magnitude and associated factor of syphilis among blood donors in the Debre-Berhan blood bank'' presented in this research thesis was original. It has not been presented to any other university or institutions. Where , the work of other people has been used, reference has been provided. In this regard, I declare this work to be our unique work.

Principal Investigator: Temesgen Belayneh

Signature: _____

Date _____