

Associations between Knowledge, Attitudes, and Practices Regarding Hepatitis B Virus Infection and HBV Infection among Blood Donors in Mogadishu, Somalia: A Hospital-based Cross-sectional Study

Abdirahman Khalif Mohamud¹, Pamornsri Inchon¹, Sirinan Suwannaporn^{1*}, Kriengkrai Prasert^{2,3}

¹Department of Public Health, School of Health Science, Mae Fah Luang University, Chiang Rai, Thailand

²Nakhon Phanom Provincial Hospital, Nakhon Phanom, Thailand

³Faculty of Public Health, Kasetsart University, Sakon Nakhon, Thailand

Received December 1, 2023
Accepted December 26, 2023
Published December 31, 2023

***Corresponding author:**

Sirinan Suwannaporn, Department of Public Health, School of Health Science, Mae Fah Luang University, Chiang Rai, Thailand

E-mail:

sirinan.suw@mfu.ac.th

©2023, Mohamud, A.K. et al.

This is an Open Access article published under a Creative Commons (CC BY-NC-ND 0.4) license.



ABSTRACT

Introduction: Globally, more than 81 million blood units are donated annually, and blood transfusion stands as a crucial medical procedure with no viable substitute. Unsafe blood transfusion contributes to 8 to 16 million new hepatitis B virus (HBV) infections, particularly in sub-Saharan Africa. Somalia faces a high demand for blood transfusions with a prevalent HBV infection rate, driven by various factors, yet no similar previous study exists. The objective of this study was to determine the associations between the knowledge, attitudes, and practices of blood donors concerning HBV infection and their infection status in Mogadishu, Somalia.

Methods: A cross-sectional study was conducted in data collection between February and April 2023, using a 5ml blood sample and a well-structured questionnaire. A rapid test was utilized to indicate HBV positivity. Univariable and multivariable logistic regressions were employed to determine the associations, considering at $\alpha = 0.050$ as statistically significant.

Results: Out of the 420 blood donors who participated in this study, 34 (8.1%) tested positive for HBV infection. The majority of the participants (94.2%) were males with an average age of 30.4 (SD $\pm$ 7.2). In multivariable logistic regression, the study revealed that blood donors with poor knowledge (AOR=5.80, 95% CI=1.69-19.89), those with moderate knowledge (AOR=4.41, 95% CI=1.09-17.90), and those with poor practices (AOR=3.52, 95% CI=1.09-11.34) toward HBV infection were more likely to become infected compared to their counterparts.

Conclusion: Blood donors in Mogadishu, Somalia, face a high burden of HBV infection. To effectively address this issue and ensure a safer blood supply, prioritizing initiatives aimed at enhancing the knowledge of blood donors regarding HBV infection is crucial. This involves educating donors about the various modes of transmission, emphasizing preventive measures, and stressing the importance of regular screenings. Additionally, encouraging better practices related to HBV infection among blood donors is essential in this endeavor.

Keywords: Knowledge, Attitudes, Practice, Blood donors, HBV infection, Somalia

Introduction

Hepatitis B is an infectious disease caused by the hepatitis B virus (HBV) that triggers liver inflammation and can potentially result in severe complications such as liver cirrhosis, failure, and cancer [1]. Classified as a well-known hepadnavirus, HBV harbors a double-stranded circular DNA genome. Globally, an estimated 296 million individuals suffer from chronic HBV infection, with approximately 1.5 million new infections

annually. HBV is responsible for about 57.0% of liver cirrhosis cases and 78.0% of liver cancer incidences [2-4]. Globally, more than 81 million blood units are donated annually, and blood transfusion stands as an indispensable therapeutic procedure lacking a viable substitute [5]. Unfortunately, unsafe blood transfusion practices contribute to 8 to 16 million new HBV infections [4, 5]. The World Health Organization (WHO) has projected around 45,000 new HBV and

HCV infections linked to unsafe transfusion practices in Sub-Saharan African countries [6]. HBV prevalence varies significantly, ranging from 2.1% to 25.9% across different regions [7-9].

Remarkably, viral hepatitis, predominantly driven by HBV, constitutes a pressing public health challenge in Africa. Studies reveal a high prevalence of HBV among African blood donors, recording rates of 4.2% in Rwanda [10], 4.1% in Calabar Nigeria [11], 14.9% in Burkina Faso [12], 5.6% in Kenya [13], 10.9% in Jijiga Ethiopia [14], and 2.0% in Eritrea [15]. While Somalia faces a high demand for blood transfusions with a high prevalence of HBV infection [16]. A meta-analysis conducted in Somalia revealed an overall pooled HBV prevalence of 18.9% [17]. The rates were even higher in specific demographics, with a prevalence of 20.5% among pregnant women, 39.2% among chronic liver disease patients, and 60% among individuals suffering from acute hepatitis [17]. Moreover, hemodialysis patients in Somalia were reported to have an HBV prevalence of 7.3% [18]. The demand for blood transfusions in clinical facilities across Somalia is notably high, driven by various factors including frequent terrorist incidents, road traffic accidents, endemic malaria resulting in anemia among children and pregnant women, as well as blood loss from surgical and obstetric procedures [19]. It is hypothesized that inadequate knowledge, lack of awareness, negative attitudes, and neglected practices among potential blood donors toward HBV infection contribute significantly to the burden of this disease in Somalia.

Insufficient understanding of HBV transmission and prevention often leads to high-risk behaviors, delaying testing and treatment efforts. This lack of awareness may neglect basic precautions and cultural practices that could otherwise mitigate disease transmission. A secure blood supply requires Up-to-date information about the association between blood donors' knowledge, attitudes, practices, and their HBV infection status. This knowledge is crucial for prevention strategies, guiding educational campaigns, ensuring a safe blood supply, limiting disease transmission, and significantly supporting eradication programs. Hence, the primary aim of this study is to investigate the association between the knowledge, attitudes, and practices of blood donors concerning HBV infection and their infection status in Mogadishu, Somalia.

Methodology

Study Design

A cross-sectional study was conducted at Banadir Public Hospital in Mogadishu, Somalia, spanning between February and April 2023.

Study Area

Mogadishu, the capital, and most densely populated city of Somalia served as the study city. Banadir hospitals, our focal point, play a pivotal role in the healthcare landscape by functioning as teaching and referral facilities. Established in 1976, these hospitals have been fundamental in providing medical and surgical care to over 3 million individuals. With a capacity exceeding 700 beds and a workforce of 400 healthcare professionals, Banadir Hospital consistently admits between 2,500 to 3,000 patients every month [20-22]. Given its substantial patient volume and significant contribution to community blood donation efforts, Banadir Hospital was selected as the ideal setting for our study.

Study Population and Eligibility Criteria

The study included all individuals over 18 years old who presented themselves at the blood donation unit of the hospital during the study period with the intent to donate blood or blood components. Exclusion criteria involved mentally unfit individuals, those unwilling to participate in the study, individuals with communication impairments or hearing deficiencies, and those who had received a dose of the HB vaccine within the last 30 days. The Centers for Disease Control and Prevention (CDC) guideline regarding HB marker interpretation suggests that individuals who received the HBV vaccine within the last 30 days might exhibit transiently positive HBsAg without being infected [23]. Hence, they were excluded from the study to ensure the accuracy of the HBV infection status assessment.

Sample Size and Sampling Technique

The study sample size was determined using a standardized formula for cross-sectional studies [24]. The formula, $n = Z_{\alpha/2}^2 P(1-P)/d^2$, where $Z_{\alpha/2}$ represents 1.96, P denotes the prevalence proportion (18.6% obtained from a similar study in Nigeria [25]), and d signifies the desired precision level of 0.05. Therefore, this study initially aimed for a total sample size of 256 respondents, accounting for a 10% non-response rate. A total of 420 participants were recruited. The selection of participants was conducted using a systematic sampling technique.

Research Instruments and Measurements

The research used a 5ml blood sample and a well-structured developed, validated, and reliable questionnaire derived from existing literature, vetted by three external experts.

The questionnaire included: i) socio-demographic characteristics; ii) twelve true or false simple dichotomy knowledge statements; iii) twelve Likert 5 scale attitude statements; and iv) ten practice statements based on frequency (always, occasionally,

never). For the knowledge section, a correct response was scored “1”, and an incorrect response received “0”. The maximum expected knowledge score was “12”, categorized as poor knowledge (<60%), moderate knowledge (60-79%), and good knowledge ($\geq 80\%$), following Bloom's cut-off point classification [26-28]. Likewise, the attitude section used a scoring system ranging from strongly disagree (1 score) to strongly agree (5 score) or vice versa for negative statements with a maximum score of 60. Responses were categorized as negative attitude (<60%), neutral attitude (60-79%), and positive attitude ($\geq 80\%$) based on Bloom's cut-off point classification [28-31]. The practice section scored “1” for correct responses (always) and “0” for incorrect responses (never and occasionally), with a maximum expected score of 10. Categories were designated as poor practice (<60%), moderate practice (60-79%), and good practice ($\geq 80\%$) based on Bloom's cut-off point classification [26-31].

The questionnaire was initially developed in English, and then verbally translated during data collection interviews. The questionnaire was validated using the Item Objective Congruence method and involved three external experts (an infectious disease specialist, a public health researcher, and a clinical epidemiologist) [32]. A pilot study with 30 participants was conducted to ensure the questionnaire content reliability and respondents' understanding, achieving an acceptable Cronbach's alpha of 0.81.

Definition of Outcome Variable

HBV infection status was determined using a rapid test on blood samples obtained at the study hospital. Positivity for HBsAg and/or anti-HBs indicated HBV infection, excluding individuals showing anti-HBc negativity, indicating an absence of HBV exposure or evidence of recent, past, resolved, or chronic HBV [23]. The HBV marker's sensitivity and specificity were as follows: HBsAg (99.85% sensitivity, 99.90% specificity), HBsAb (99.70% sensitivity, 99.41% specificity), HBeAg (100% sensitivity, 100% specificity), HBeAb (99.34% sensitivity, 90.93% specificity), and HBcAb (99.78% sensitivity, 99.74% specificity) [33]. Interpretation followed the CDC's standardized HB serological guideline [23].

Data Collection Procedure

Five qualified licensed nurses underwent a three-day training session covering research procedures, eligibility criteria, blood sample collection techniques, and questionnaire content. Eligible participants were briefed about the study's objectives and invited to participate. Those who agreed signed a written consent form or provided a fingerprint for illiterate participants. Data collectors obtained a 5ml blood sample and conducted face-to-face interviews using the research tool, averaging 20 minutes per participant.

Data Processing and Analysis

The collected data was cleaned, coded, and entered into a spreadsheet. Subsequently, imported into SPSS version 20 (SPSS, Chicago, IL) for comprehensive analysis. Descriptive statistics were used to present a clear overview of the general characteristics. Categorical data were expressed as frequencies with percentages, while continuous data were presented as means with standard deviations (SD). Knowledge scores were based on correct (1) or incorrect (0) answers, the maximum expected score was 12. They were then grouped as poor knowledge (<60%), moderate knowledge (60-79%), and good knowledge ($\geq 80\%$) following Bloom's cutoff point classification [26-28].

Attitude scores ranged from strongly disagree (1) to strongly agree (5), or their opposites for negative statements, with a maximum score of 60. Responses were categorized as negative attitude (<60%), neutral attitude (60-79%), or positive attitude ($\geq 80\%$) according to Bloom's cutoff point classification [28-31]. Practice scores assigned 'always' as correct (1) and 'never'/'occasionally' as incorrect (0), leading to a maximum score of 10. These were grouped as poor practice (<60%), moderate practice (60-79%), and good practice ($\geq 80\%$) aligning with Bloom's cutoff point classification [26-31].

Univariable and multivariable models of logistic regression were used to explore the potential associations between the outcome and independent variables. Variables demonstrating a p-value of ≤ 0.25 were selected as candidates for inclusion in the multivariate logistic regression analysis following suggestions of Bursac et al. [34], indicating that variables with a p-value ≤ 0.25 in univariate logistic regression might hold a reasonable association with the final model's outcome due possibility of having a potential confounding variable. The Hosmer-Lemeshow goodness-of-fit test was used to indicate the goodness of fit for the final model. In the multivariable logistic regression analysis, variables exhibiting a p-value of ≤ 0.05 were considered statistically significant.

Results

Hepatitis B Virus Infection Status

A total of 420 blood donors participated in this study, 34 (8.1%) tested positive for HBV infection, while 386 (91.9%) tested negative.

Socio-Demographic Characteristics

The study comprised that the majority (94.2%) of the respondents are male with an average age of 30.4 (SD ± 7.2). Most respondents 67.1% were single, 32.6% were illiterate, and 41.2% were employers with an average monthly income of 427.20 USD. In addition, there is a statistical association between demographical variables and HBV infection (Table 1).

Table 1 Socio-demographical characteristics between HBV-infected and non-infected

Characteristics	HBV infection		p-value
	No n (%)	Yes N (%)	
Sex			0.965
Male	364 (91.9%)	32(8.1%)	
Female	22 (91.7%)	2(8.3%)	
Age (years)			0.124
18-28	154 (90.6%)	16(9.4%)	
29-39	190 (91.3%)	18(8.7%)	
≥40	42(100.0%)	0(0.0%)	
	<i>Mean=30.4 (SD±7.2)</i>		
Marital status			0.112
Single	255(90.4%)	27(9.6%)	
Ever Married	131 (94.9%)	7 (5.1%)	
Education			0.874
Illiterate	124(90.5%)	13(9.5%)	
Read or write	92(92.0%)	8(8.0%)	
Primary level	110(92.4%)	9(7.6%)	
Post-primary	60(93.8%)	4(6.2%)	
Occupation			0.856
Employee	158(91.3%)	15(8.7%)	
Business	103(92.0%)	9(8.0%)	
Healthcare	54(94.7%)	3(5.3%)	
Jobless	71(91.0%)	7(9.0%)	
Residential area			0.089
Rural	81(96.4%)	3(3.6%)	
Urban	305(90.8%)	31(9.2%)	
Income \$USD			0.437
<200	105 (91.3%)	10 (8.7%)	
200-400	126 (90.0%)	14 (10.0%)	
>400	155 (93.9%)	10 (6.1%)	

*Significant level at $\alpha=0.05$ **KAP of Blood Donors Regarding HBV Infection**

The results reveal a substantial association between the HBV infection status of blood donors and their knowledge (p-value = 0.007), attitude (p-value = 0.047), and practices (p-value = 0.057), all significant at a level of ≤ 0.25 (Table 2).

Table 2 Knowledge, attitudes, and practices of blood donors regarding HBV Infection

Characteristics	HBV infection		p- value
	No n (%)	Yes n (%)	
Level of knowledge			
Poor	180 (88.2%)	24 (11.8%)	0.007*
Moderate	75 (91.5%)	7 (8.5%)	
Good	131 (97.8%)	3 (2.2%)	
Level of Attitude			
Negative	56 (84.8%)	10 (15.2%)	0.047*
Neutral	295 (92.8%)	23 (7.2%)	
Positive	35 (97.2%)	1 (2.8%)	
Level of Practice			
Poor	91 (86.7%)	14 (13.3%)	0.057*
Moderate	210 (92.9%)	16 (7.1%)	
Good	85 (95.5%)	4 (4.5%)	

* Significant at $\alpha=0.25$ **Factors associated with HBV infection**

In the univariable logistic regression model, several factors including blood donors' age, marital status, resident area, knowledge, attitude, and practice showed significant associations with HBV infection at a significance level of $\alpha=0.25$. These variables were selected as potential candidates for inclusion in the multivariable logistic regression model. Subsequently, variables with $\alpha=0.05$ were considered statistically significant and presented in Table 3.

In multivariable logistic regression, the study found that blood donors with poor knowledge regarding HBV infection were 5.80 times more likely (95% CI = 1.69-19.89) to contract HBV compared to those with good knowledge. Similarly, individuals with moderate knowledge displayed 4.41 times higher odds (95%CI=1.09-17.90) of HBV infection compared to those with good knowledge. Furthermore, participants demonstrating poor practices concerning HBV infection showed 3.52 times higher odds (95% CI=1.09-11.34) of acquiring HBV compared to individuals who practice good habits.

Table 3 Associations between KAP and HBV Infection in univariable and multivariable models

Characteristics	OR (95%CI)	p- value	AOR (95%CI)	p-value
Age (years)				
18-28	1.33 (0.66-2.70)	0.416		
≥ 29	1.00			
Marital status				
Single	1.98 (0.84-4.67)	0.118		
Ever Married	1.00			
Residential area				
Rural	1.00	0.102		
Urban	2.74 (0.81-9.20)			
Knowledge				
Poor	5.82 (1.71-19.74)	0.005	5.80 (1.69-19.89)	0.005*
Moderate	4.07 (1.02-16.23)	0.046	4.41 (1.09-17.90)	0.037*
Good	1		1	
Attitude				
Negative attitude	6.25 (0.76-50.96)	0.087		
Neutral attitude	2.72 (0.35-20.83)	0.333		
Positive attitude	1.00			
Practice				
Poor	3.26 (1.03-10.32)	0.043	3.52 (1.09-11.34)	0.035*
Moderate	1.61 (0.52-4.98)	0.401	1.93 (0.61-6.05)	0.256
Good	1.00		1	

* Significant at p-value <0.05

Discussion

This study involved 420 blood donors, nearly half of whom exhibited inadequate knowledge about the HBV. Such gaps significantly impact disease transmission rates and individual HBV infection statuses. These knowledge deficiencies often lead individuals to unknowingly engage in behaviors contributing to increased transmission. This finding aligns with a similar study in Pakistan, underscoring a rise in HBV cases due to insufficient awareness or misconceptions about HBV transmission [35].

Furthermore, limited knowledge about the HBV vaccine has resulted in low vaccination rates, thereby increasing the risk of infection. Surprisingly, investigations into HBV vaccination rates in our specific area revealed an alarmingly low rate of complete vaccination, with only 16.0% of participants having received full vaccination. Reasons cited for non-vaccination included vaccine unavailability and high costs [36], consistent with findings from various other studies [37-39]. These results highlight the urgent need to improve vaccine uptake by addressing obstacles such as enhancing vaccine availability and reducing costs. Moreover, implementing educational campaigns is crucial in mitigating HBV transmission, advocating vaccination, limiting viral spread, and facilitating early diagnosis and treatment.

The reported HBV infection rate of 8.1% among collected samples in this study is lower than in similar studies in Burkina Faso [12], Kenya [13], Jijiga, Ethiopia [14], Eritrea [15], Nigeria [25], Ghana [40], Equatorial Guinea [41]. Conversely, this prevalence is higher than in comparative studies conducted in Tanzania [42], and other regions of Ethiopia [43]. These disparities might arise from various factors, including diverse risk factors among blood donors, variations in population and geographical locations, differences in vaccine accessibility and availability, varied exposure to infections, dissimilar risk factors, individual beliefs, and cultural influences, as well as demographic and economic disparities. Furthermore, differences in immunity statuses and sample sizes among the studies might have contributed to these variations.

This study revealed that three-fourths of the participating blood donors held a neutral attitude toward HBV infection, while a small number of them had a positive attitude. Attitudes toward HBV infection significantly influence individual and community responses. A negative or neutral stance often leads to limited awareness, hindering healthcare-seeking behavior and reducing community-wide efforts in prevention and support. This can lead to increased transmission rates, delayed diagnosis, and reduced access to necessary resources, perpetuating the cycle of infection and impeding effective control measures. A similar study reported that cultural and religious beliefs, coupled with a lack of knowledge and awareness about

HBV, act as barriers to HBV screening and care [44]. Conversely, a positive attitude encourages education, proactive health-seeking behavior, and increased community support, ultimately aiding in prevention, early diagnosis, and improved access to care. Another similar study highlighted how inadequate knowledge or beliefs about HBV and its transmission can contribute to low vaccination rates within certain communities [45]. Addressing these attitudes and beliefs through targeted education and awareness campaigns, as recommended in previous studies, is crucial in increasing HBV screening, vaccination, and overall prevention efforts [46, 47].

This study found that blood donors with poor or moderate knowledge regarding HBV infection were over five and four times more likely, respectively, to become HBV infected compared to those with good knowledge. The association between a lack of knowledge about HBV infection and a higher likelihood of becoming infected is well-established. Lack of knowledge or inadequate awareness about how the virus spreads preventive measures and the availability of vaccination can contribute to an increased risk of HBV infection. Other factors such as misconceptions about transmission routes, inadequate knowledge about safe sex practices, needle sharing, or improper handling of contaminated blood or body fluids can exacerbate the situation. A previous study conducted in the same area reported inadequate knowledge of HBV and recommended tailored health education programs for this vulnerable population [48]. Furthermore, a similar study from Ghana highlighted the significant association between poor HBV knowledge and a high prevalence of HBV infection [49]. However, our study emphasizes the importance of implementing educational campaigns, and public health initiatives, and providing accurate information about HBV transmission and prevention to reduce the risk of infection.

Finally, this study revealed that individuals with poor practices toward HBV infection were over three times more likely to become HBV-infected compared to those with good practices. Poor practices toward HBV can lead to exposure to various risky behaviors or practices, as HBV primarily spreads through contact with infectious bodily fluids or blood, posing a considerable risk to individuals engaging in certain activities. Reducing these risks involves adopting safe practices, such as practicing safe sex, avoiding needle sharing, ensuring sterilized medical environments, and getting vaccinated against HBV. A similar study highlighted how stigmatizing attitudes can directly influence the HBV infection status in the community and suggested that having accurate knowledge of disease processes and being sufficiently educated may not be enough to prevent the disease without adequate practice [50]. One more study reported a low correlation between knowledge and attitudes toward HBV infection [51]. Moreover, African studies

reported a high prevalence of HBV infection attributed to poor practices toward the disease and its transmission, recommending high-quality tailored education programs targeting young students to combat disease transmission [51-53]. Therefore, our study reiterates the importance of maintaining proper hygiene, refraining from sharing personal items, particularly those contaminated with blood, and exercising caution in occupational settings as crucial preventive measures against HBV transmission.

However, the nature of this study being cross-sectional implies that it is unable to establish a definitive cause-and-effect relationship between the factors examined and the observed outcomes.

Conclusion

Blood donors in Mogadishu, Somalia, face a significant challenge of HBV infection. To effectively combat this issue and ensure a safer blood supply, it is crucial to prioritize initiatives aimed at enhancing the knowledge and practices of blood donors regarding HBV infection. Specifically, interventions should focus on educating donors about the various modes of transmission, emphasizing preventive measures, and stressing the importance of regular screenings. Encouraging better practices related to HBV infection among blood donors is essential in this endeavor. Moreover, it is highly recommended to implement collaborative efforts involving governmental health agencies, non-governmental organizations, and community leaders. These partnerships can play a pivotal role in nurturing a culture of awareness, prevention, and responsible behavior concerning HBV infection. By concentrating on education, improving practices, and fostering collaborative initiatives, we can make significant strides in reducing the burden of HBV infection among blood donors in Mogadishu, Somalia, thereby ensuring a safer and healthier blood supply for the community.

Ethical Approval and Study Considerations

This study rigorously followed the guidelines outlined in the World Medical Association's declaration of Helsinki. Ethical clearance was granted by the Ethical Committee on Human Research at Mae Fah Luang University, Muang, Chiang Rai, Thailand, with protocol number (22205-18). Before joining, all eligible participants received detailed information about the study's objectives and were invited to take part. People who could read provided written consent by signing a form. For those who couldn't read, their legal representatives helped them understand the consent form, and they agreed to participate by providing their fingerprints instead of a signature. This ensured that their involvement was voluntary and free from pressure. Additionally, participants were informed that they could choose to participate or stop the interview at any time. The study strictly maintained confidentiality by

anonymizing questionnaires and presenting data only in collective form without disclosing individual identities.

Acknowledgements

The authors extend their gratitude to the healthcare workers at the study hospital and the altruistic blood donors for their invaluable cooperation and provision of essential information.

References

- [1] Roien R, Mousavi SH, Ozaki A, Baqeri SA, Hosseini SM, Ahmad S, Shrestha S. Assessment of knowledge, attitude, and practice of health-care workers towards hepatitis B virus prevention in Kabul, Afghanistan. *Journal of Multidisciplinary Healthcare*. 2021;3177-86.DOI: 10.2147/JMDH.S334438
- [2] Woodring J, Pastore R, Brink A, Ishikawa N, Takashima Y, Tohme RA. Progress toward hepatitis B control and elimination of mother-to-child transmission of hepatitis B virus—Western Pacific Region, 2005–2017. *Morbidity and Mortality Weekly Report*. 2019;68(8):195.DOI: 10.15585/mmwr.mm6808a2
- [3] Yigezu H, Temam J, Bajiro M, Tesfaye Jule L, Nagaprasad N, Roy A, Saka A, Ramaswamy K. Factors associated with the prevalence of hepatitis B among volunteer blood donors at Jimma Blood Bank, South Ethiopia. *Canadian Journal of Gastroenterology and Hepatology*. 2022;2022. DOI: 10.1155/2022/7458747
- [4] Liu B, Wen X, Huang C, Wei Y. Unraveling the complexity of hepatitis B virus: from molecular understanding to therapeutic strategy in 50 years. *The International Journal of Biochemistry & Cell Biology*. 2013;45(9):1987-96. DOI: 10.1016/j.biocel.2013.06.017
- [5] Abebe M, Alemnew B, Biset S. Prevalence of hepatitis B virus and hepatitis C virus among blood donors in nekemte blood bank, Western Oromia, Ethiopia: retrospective 5 years study. *Journal of Blood Medicine*. 2020;543-50.DOI: 10.2147/JBM.S282099
- [6] McNaughton AL, Lourenço J, Bester PA, Mokaya J, Lumley SF, Obolski U, Forde D, Maponga TG, Katumba KR, Goedhals D, Gupta S. Hepatitis B virus seroepidemiology data for Africa: Modelling intervention strategies based on a systematic review and meta-analysis. *PLoS medicine*. 2020 Apr 21;17(4):e1003068. DOI.org/10.1371/journal.pmed.1003068
- [7] Fattahi MR, Safarpour A, Sepehrimanesh M, Asl SM, Mohamaddoust F. The prevalence of hepatitis C virus infection and its related risk factors among the rural population of fars province, southern Iran. *Hepatitis Monthly*. 2015;15(2). DOI: 10.5812/hepatmon.24734

- [8] Hussein NR, Haj SM, Almizori LA, Taha AA. The prevalence of hepatitis B and C viruses among blood donors attending blood bank in Duhok, Kurdistan region, Iraq. *International Journal of Infection*. 2017;4(1). DOI: <https://doi.org/10.17795/iji-39008>
- [9] Schillie S, Vellozzi C, Reingold A, Harris A, Haber P, Ward JW, Nelson NP. Prevention of hepatitis B virus infection in the United States: recommendations of the advisory committee on immunization practices. *MMWR Recommendations and Reports*. 2018;67(1):1. DOI: 10.15585/mmwr.rr6701a1
- [10] Makuza JD, Rwema JO, Ntihabose CK, Dushimiyimana D, Umutesi J, Nisingizwe MP, et al. Prevalence of hepatitis B surface antigen (HBsAg) positivity and its associated factors in Rwanda. *BMC Infectious Diseases*. 2019;19:1-0. DOI: 10.1186/s12879-019-4013-4
- [11] Okoroiwu HU, Okafor IM, Asemota EA, Okpokam DC. Seroprevalence of transfusion-transmissible infections (HBV, HCV, syphilis and HIV) among prospective blood donors in a tertiary health care facility in Calabar, Nigeria; An eleven years evaluation. *BMC Public Health*. 2018;18(1).
- [12] Nagalo MB, Sanou M, Bisseye C, Kaboré MI, Nebie YK, Kienou K, et al. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis among blood donors in Koudougou (Burkina Faso) in 2009. *Blood transfusion*. 2011;9(4):419. DOI: 10.2450/2011.0112-10
- [13] Bartonjo G, Oundo J, Ng'ang'a Z. Prevalence and associated risk factors of transfusion transmissible infections among blood donors at regional blood transfusion center nakuru and tenwek mission hospital, Kenya. *Pan African Medical Journal*. 2019;34. DOI: 10.11604/pamj.2019.34.31.17885
- [14] Mohammed Y, Bekele A. Seroprevalence of transfusion transmitted infection among blood donors at Jijiga blood bank, Eastern Ethiopia: Retrospective 4 years study infectious diseases. *BMC Res Notes*. 2016;9(1). DOI: 10.1186/s13104-016-1925-6
- [15] Siraj N, Achila OO, Issac J, Menghisteb E, Hailemariam M, Hagos S, et al. Seroprevalence of transfusion-transmissible infections among blood donors at National Blood Transfusion Service, Eritrea: a seven-year retrospective study. *BMC Infectious Diseases*. 2018;18(1):1-9. DOI: 10.1186/s12879-018-3174-x
- [16] Nur YA, Groen J, Elmi AM, Ott A, Osterhaus ADME. Prevalence of serum antibodies against bloodborne and sexually transmitted agents in selected groups in Somalia. *Epidemiol Infect*. 2000;124(1):137-41. DOI: 10.1017/s0950268899003441
- [17] Hassan-Kadle MA, Osman MS, Ogurtsov PP. Epidemiology of viral hepatitis in Somalia: systematic review and meta-analysis study. *World J Gastroenterol*. 2018 Sep 14;24(34):3927-57. DOI: 10.3748/wjg.v24.i34.3927
- [18] Osman M, Jeele O, Omar R, Addow B, Adan FN, Jimale LH. Prevalence and risk factors associated with hepatitis B and hepatitis C infections among patients undergoing hemodialysis: a single-centre study in Somalia. 2021. Available from: DOI: 10.1155/2021/1555775
- [19] Mohamud MH, Aweis AD, Adam AS, Mohamed FA, Fidow SQ, Mohamed LM. Distribution and frequency of ABO and rhesus (D) blood groups in Somalia: a retrospective study on students of Jazeera University, Mogadishu-Somalia. *BioMed Research International*. 2022;2022. DOI: 10.1155/2022/7981325
- [20] Mohamud AK, Ahmed OA, Mohamud AA, Dirie NI. Prevalence of and factors associated with depression among adult patients living with HIV/AIDs undergoing ART unit in Banadir hospital, Mogadishu Somalia. *BMC Psychiatry*. 2023 Dec;23(1):1-8. DOI: 10.1186/s12888-023-04723-x
- [21] Mohamud AK, Ahmed OA, Ali IA, Dirie NI. Demographical, clinical, and complication differences between vaccinated and unvaccinated hospitalized children with measles in Mogadishu Somalia: a hospital-based retrospective cohort study. *Annals of Medicine and Surgery*. 2023;85(5):1550. DOI: 10.1097/MS9.0000000000000672
- [22] Mohamud AK, Ahmed OA, Mohamud AA, Dirie NI. Magnitude of opportunistic infections and associated factors among adult people living with human immune deficient virus on art at selected public hospital, Mogadishu Somalia: cross-sectional study. *Annals of Medicine and Surgery*. 2023;85(7):3364-71. DOI: 10.1097/MS9.0000000000000880
- [23] Centers for Disease Control and Preventions (CDC). Interpretation of hepatitis B serologic test results.Available from: <https://www.cdc.gov/hepatitis/hbv/interpretationOfHepBSerologicResults.htm#print>
- [24] Charan J, Biswas T. How to calculate sample size for different study designs in medical research?. *Indian Journal of Psychological Medicine*. 2013;35(2):121-6. DOI: 10.4103/0253-7176.116232
- [25] Buseri FI, Muhibi MA, Jeremiah ZA. Sero-epidemiology of transfusion-transmissible infectious diseases among blood donors in Osogbo, south-west Nigeria. *Blood Transfusion*. 2009;7(4):293. DOI: 10.2450/2009.0071-08

- [26] Dauda Goni M, Hasan H, Naing NN, Wan-Arfah N, Zeiny Deris Z, Nor Arifin W, et al. Assessment of knowledge, attitude and practice towards prevention of respiratory tract infections among Hajj and Umrah Pilgrims from Malaysia in 2018. *International Journal of Environmental Research and Public Health*. 2019; 16(22):4569. DOI: 10.3390/ijerph16224569
- [27] Kanu S, James PB, Bah AJ, Kabba JA, Kamara MS, Williams CE, et al. Healthcare workers' knowledge, attitude, practice and perceived health facility preparedness regarding COVID-19 in Sierra Leone. *Journal of Multidisciplinary Healthcare*. 2021;67-80. DOI: 10.2147/JMDH.S287156
- [28] Salman M, Mustafa Z, Asif N, Zaidi HA, Shehzadi N, Khan TM, et al. Knowledge, attitude and preventive practices related to COVID-19 among health professionals of Punjab province of Pakistan. *The Journal of Infection in Developing Countries*. 2020;14(07):707-12. DOI: 10.3855/jidc.12878
- [29] Mohamud AK, Ali IA, Ali AI, Dirie NI, Inchon P, Ahmed OA, et al. . Assessment of healthcare workers' knowledge and attitude on Ebola virus disease in Somalia: a multicenter nationwide survey. *BMC Public Health*. 2023;23(1):1650. DOI: 10.1186/s12889-023-16562-2
- [30] Yu PL, Ab Ghafar N, Adam M, Goh HC. Understanding the human dimensions of recycling and source separation practices at the household level: an evidence in Perak, Malaysia. *Sustainability*. 2022;14(13):8023. Doi.org/10.3390/su14138023
- [31] Nguyen HB, Nguyen TH, Tran TT, Vo TH, Tran VH, Do TN, et al. Knowledge, attitudes, practices, and related factors towards COVID-19 prevention among patients at university medical center Ho Chi Minh City, Vietnam. *Risk Management and Healthcare Policy*. 2021;2119 32. DOI: 10.2147/RMHP.S305959
- [32] Turner RC, Carlson L. Indexes of item-objective congruence for multidimensional items. *International Journal of Testing*. 2003;3(2):163-71. doi.org/10.1207/S15327574IJT0302_5
- [33] Intec Products (INC). Advanced quality one step multi-HBV test is a rapid, qualitative, immunoassay for the determination of HBV markers. Available from: https://www.intecasi.com/one-step-multi-hbv-test-device_p19.html
- [34] Bursac Z, Gauss CH, Williams DK, Hosmer DW. Purposeful selection of variables in logistic regression. *Source code for biology and medicine*. 2008;3(1):1-8. doi:10.1186/1751-0473-3-17
- [35] Haq N, Hassali MA, Shafie AA, Saleem F, Farooqui M, Aljadhey H. A cross sectional assessment of knowledge, attitude and practice towards Hepatitis B among healthy population of Quetta, Pakistan. *BMC Public Health*. 2012;12:1-8. DOI: 10.1186/1471-2458-12-692
- [36] Hussein NA, Ismail AM, Jama SS. Assessment of hepatitis B vaccination status and associated factors among healthcare workers in Bosaso, Puntland, Somalia 2020. *BioMed Research International*. 2022;2022. DOI: 10.1155/2022/9074294
- [37] Dirie NI, Adam MH, Garba B, Dahie HA, Nur MA, Mohamed FY, et al. The prevalence of urolithiasis in subjects undergoing computer tomography in selected referral diagnostic centers in Mogadishu, Somalia. *Frontiers in Public Health*. 2023;11. DOI: 10.3389/fpubh.2023.1203640
- [38] Ali AI, Aden AI, Mohamud AK. Dermoscopic findings in Tinea Capitis among under 18 children in dermatology polyclinic patients: a hospital-based cross-sectional study. *Annals of Medicine and Surgery*. 2023;10-97. DOI: 10.1097/MS9.0000000000001530
- [39] Ganczak M, Dmytryk-Daniłow G, Korzeń M, Drozd-Dąbrowska M, Szych Z. Prevalence of HBV infection and knowledge of hepatitis B among patients attending primary care clinics in Poland. *Journal of community health*. 2016;41:635-44. DOI: 10.1007/s10900-015-0139-5
- [40] Dongdem JT, Kampo S, Soyiri IN, Asebga PN, Ziem JB, Sagoe K. Prevalence of hepatitis B virus infection among blood donors at the Tamale Teaching Hospital, Ghana (2009). *BMC Research Notes*. 2012 Dec;5(1):1-5. DOI: 10.1186/1756-0500-5-115
- [41] Xie DD, Li J, Chen JT, Eyi UM, Matesa RA, Obono MM, et al. Seroprevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus, and treponema pallidum infections among blood donors on Bioko Island, Equatorial Guinea. *PloS one*. 2015;10(10):e0139947. DOI: 10.1371/journal.pone.0139947
- [42] Matee MI, Magesa PM, Lyamuya EF. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis infections among blood donors at the Muhimbili National Hospital in Dar Es Salaam, Tanzania. *BMC Public Health*. 2006;6(1):1-6. DOI: 10.1186/1471-2458-6-21
- [43] Tessema B, Yismaw G, Kassu A, Amsalu A, Mulu A, Emmrich F, et al. Seroprevalence of HIV, HBV, HCV and syphilis infections among blood donors at Gondar University Teaching Hospital, Northwest Ethiopia: declining trends over a period of five years. *BMC Infectious Diseases*. 2010;10:1-7. DOI: 10.1186/1471-2334-10-111

- [44] Freeland C, Bodor S, Perera U, Cohen C. Barriers to hepatitis B screening and prevention for African immigrant populations in the United States: a qualitative study. *Viruses*. 2020;12(3):305. DOI: 10.3390/v12030305
- [45] Mukhtar NA, Evon DM, Yim C, Lok AS, Lisha N, Lisker-Melman M, et al. Patient knowledge, beliefs and barriers to hepatitis B care: results of a multicenter, multiethnic patient survey. *Digestive Diseases and Sciences*. 2021;66:434-41. DOI: 10.1007/s10620-020-06224-3
- [46] Xiong M, Nguyen RH, Strayer L, Chanthanouvong S, Yuan JM. Knowledge and behaviors toward hepatitis B and the hepatitis B vaccine in the Laotian community in Minnesota. *Journal of Immigrant and Minority Health*. 2013;15:771-8. DOI: 10.1007/s10903-012-9768-2
- [47] Mohamud AK, Mohamud BI. Knowledge, attitude, and practice of pregnant women toward Intermittent preventive treatment during pregnancy in selected medical centers in banadir region, Mogadishu Somalia: a cross-sectional study. Available from: <https://doi.org/10.21203/rs.3.rs-1702975/v2>
- [48] Moussa AA, Abdi AA, Abdullahi SA. Assessment of knowledge, attitude and practice of healthcare workers towards Hepatitis B virus infection in Mogadishu, Somalia: a cross-sectional study. Available from: <https://doi.org/10.21203/rs.2.23628/v1>
- [49] Adoba P, Boadu SK, Agbodzakey H, Somuah D, Ephraim RK, Odame EA. High prevalence of hepatitis B and poor knowledge on hepatitis B and C viral infections among barbers: a cross-sectional study of the Obuasi municipality, Ghana. *BMC Public Health*. 2015;15(1):1-7. DOI 10.1186/s12889-015-2389-7
- [50] Ghazzawi M, Yendewa SA, James PB, Massaquoi SP, Babawo LS, Sahr F, et al. Assessment of knowledge, stigmatizing attitudes and health-seeking behaviors regarding hepatitis B virus infection in a pharmacy and community setting in Sierra Leone: a cross-sectional study. *InHealthcare* 2023; 11(2): 177. MDPI. Doi.org/10.3390/healthcare11020177
- [51] Bhasker B, Sachdev S, Marwaha N, Grover S, Singh T, Dhiman RK. Knowledge and attitude regarding hepatitis B and C among blood donors and nondonors in North India. *Journal of Clinical and Experimental Hepatology*. 2019;9(3):318-23. DOI: 10.1016/j.jceh.2018.08.005
- [52] Gebremeskel T, Beshah T, Tesfaye M, Beletew B, Mengesha A, Getie A. Assessment of knowledge and practice on hepatitis B infection prevention and associated factors among health science students in Woldia University, Northeast Ethiopia. *Advances in Preventive Medicine*. 2020;2020. DOI: 10.1155/2020/9421964
- [53] Samje M, Sop S, Tagny CT, Mbanya D. Knowledge, attitude and seropositivity of hepatitis B virus among blood donors in the Bamenda Regional Hospital Blood Bank, Cameroon. *Pan African Medical Journal*. 2021;39(1). DOI: 10.11604/pamj.2021.39.33.28911