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Epidemiology of Hepatitis B Virus (HBV) Infection Among Blood Donors at Al-Manaqil Educational Hospital Blood Bank, Gezira State, Sudan, 2025

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Abstract

Background: *Hepatitis B virus (HBV) infection is a major global health problem, affecting approximately 300 million people worldwide and causing liver disease.* ***Objective:*** *To study the epidemiology of HBV among blood donors at Al-Manaqil Educational Hospital Blood Bank.* ***Methods****: A descriptive cross-sectional study was conducted on 386 male blood donors from September to December 2023. Data were collected via structured questionnaires and laboratory screening for HBsAg using immunochromatographic tests (ICT), confirmed by ELISA. Analysis used SPSS version 26 with chi-square tests (P<0.05 significant).* ***Results:*** *Overall prevalence was 3.6%. Higher rates were observed in the 20-26 age group (6.0%), healthcare workers (44.4%), singles (5.2%), university-educated donors (7.1%), and unvaccinated individuals (4.2%). Risk factors included family history (27.3%) and medical injuries (12.0%). Knowledge gaps existed, with 56-63% unaware of HBV.* ***Recommendations:*** *Enhance screening with nucleic acid testing (NAT), promote mass vaccination, and conduct targeted health education.*

Keywords*: Hepatitis B, blood donors, blood bank, blood transfusion, Al-Manaqil Educational Hospital.*

INTRODUCTION

Blood transfusion services constitute a critical component of modern healthcare systems, providing life-saving support for medical and surgical patients worldwide (Hall, 2008). However, ensuring the safety and quality of blood supplies remains paramount to prevent transfusion-transmitted infections, particularly hepatitis B virus (HBV) (Elsharif et al., 2015). HBV infection represents a major global public health challenge, affecting an estimated 257 million people chronically and causing 887,000 deaths in 2015 from complications including cirrhosis and hepatocellular carcinoma (Wang et al., 2021).

The virus primarily targets the liver, leading to acute or chronic inflammation that impairs its vital functions of nutrient processing, blood filtration, and infection defense (CDC, 2016). Transmission occurs through percutaneous or mucosal exposure to infected blood or bodily fluids, with well-established risks in healthcare settings, including needlestick injuries, contaminated medical instruments, and inadequate sterilization practices (Nagoor et al., 2021). Although routine HBsAg screening of blood donations has been implemented since 1970, the window period between infection and detectable antigenemia continues to pose transfusion risks, particularly in high-prevalence regions (Attia and Elmetwalli, 2021).

Africa bears the highest HBV burden globally, with 6.1% prevalence in the WHO African Region (Donkor, 2018). In Sudan, heterogeneous endemicity persists, with blood donor studies reporting rates from 0.33% to 7% across regions (Elsharif et al., 2015; Mohamed et al., 2022). Healthcare workers face elevated occupational hazards due to frequent blood exposure, compounded by suboptimal vaccination coverage and knowledge gaps regarding universal precautions (Bakry et al., 2012). Effective HBV vaccines, administered since 1982, have dramatically reduced chronic infection rates from 8-15% to <1% in immunized child cohorts (Nagoor et al., 2021).

Despite national immunization programs, Sudan continues to report substantial HBV reservoirs, estimated near one million carriers (Saudi Ministry of Health data analogy; Nagoor et al., 2021). Blood banks serve as sentinel surveillance points for community prevalence, yet local data from Gezira State remain limited. This study addresses this gap by investigating HBV epidemiology among blood donors at Al-Manaqil Educational Hospital Blood Bank, examining prevalence, demographic associations, risk factors, and knowledge levels to inform targeted interventions.

Problem of the study

Hepatitis B constitutes a major transmissible hazard through blood transfusion services in resource-limited settings. In Sudan, inconsistent donor

screening, variable vaccination coverage, and occupational exposures among healthcare personnel perpetuate transmission risks. Existing regional studies document prevalence heterogeneity, but Gezira State data specific to blood donors are scarce, hindering evidence-based blood safety policies.

Objectives of the study

Main Objective

To determine the epidemiology of hepatitis B virus infection among blood donors at Al-Manaqil Educational Hospital Blood Bank, Gezira State, Sudan.

Specific Objectives

To determine HBV prevalence among blood donors through HBsAg screening.

To identify socio-demographic factors associated with HBV positivity.

To assess risk factors for HBV transmission among study participants.

To evaluate donors' knowledge regarding HBV etiology, transmission, and prevention.

Materials and Methods of the study

Study Design and Period

A descriptive cross-sectional study was conducted among blood donors attending Al-Manaqil Educational Hospital Blood Bank from September to December 2023.

Study Area

Al-Manaqil Locality, Gezira State, Sudan (latitudes 13°45'-14°15'N, longitudes 33°30'-34°15'E) spans 6,250 km² with an estimated population of 678,441, predominantly agricultural communities from Al-Kawahla, Musalmia, Rufaa, and Al-Kenana tribes. The locality hosts 5 public hospitals, 2 private hospitals, 13 health centers, and the studied blood bank established in 1962. The blood bank

facility comprises a reception hall, doctor's room, derivatives room, refrigeration units, and plasma separation area, staffed by 6 personnel operating in shifts.

Study Population

All male blood donors attending the blood bank during the study period who provided informed consent.

Inclusion Criteria

Blood donors aged ≥18 years attending Al-Manaqil Educational Hospital Blood BankWilling to participate and provide written informed consentAgreed to HBsAg testing

Exclusion Criteria

High-risk groups: thalassemia clinic patients, sexually transmitted infection clinic attendees, injecting drug users Donors refusing HBsAg testing or study participation Females (due to blood bank donor demographics during study period)

Sample Size and Sampling Technique

Sample size calculated using Fisher's formula assuming 50% prevalence, 95% confidence level, and 5% margin of error: The sample size was calculated using fishers formula (fisher *et al. 2008*) was used determine the sample size using 50%prevelara

$$N = \frac{Z2\ P\ (1 - P)}{D2}$$

N = required minimum sample

Z = 1,96 normal error

P = 0,5

D = 0,05 the inverse of 95% confidence limit

$$N = \frac{(1,96)\ 2\ \times 0,5(1-0,5)}{(0,05)2}$$

N = 384,16

There 384 blood donors were recruit into study.Actual sample :386(100% coverage)

Data Collection Tools

Structured questionnaire administered via face-to-face interviews, comprising three sections:

Part A: Socio-demographics (age, occupation, marital status, education, income)

Part B: Risk factors (surgery history, blood transfusion, medical injuries, family history, vaccination status)

Part C: HBV knowledge (etiology, symptoms, complications, prevention)

4.8 Laboratory Methods HBsAg Screening Protocol:ICT: Rapid immunochromatographic test (80µL serum/plasma/whole blood, results at 15 minutes)ELISA Confirmation: All ICT positives confirmed; negatives for quality controlICT Interpretation: Control (C) + Test (T) lines = Positive; C only = Negative.

ELISA Protocol: Commercial kits per manufacturer specifications with positive/negative controls and cut-off calculation (mean NC × 0.05).

Data Analysis

Data entered and analyzed using SPSS version 26. Descriptive statistics (frequencies, percentages) summarized variables. Chi-square tests assessed associations between HBsAg status and independent variables ($P<0.05$ significant). Prevalence ratios and relative risks calculated.

Ethical Considerations

The study adhered to ethical principles of validity, integrity, beneficence, non-maleficence, justice, and respect for persons (Belmont Report). Key measures included:

Ethical Approval: Obtained from Al-Manaqil Educational Hospital administration and Blood Bank Director

Informed Consent: Written consent/assent from all participants after explaining study purpose, procedures, risks, benefits, and voluntary participation rights

Confidentiality: Anonymized data collection and storage; blood samples labeled with codes

Beneficence/Non-maleficence: Free HBV testing and counseling for positives; no study-related harmJustice: Equal inclusion opportunity for eligible donorsRight to Withdraw: Participants could withdraw anytime without prejudice

Result :

A total of 386 male blood donors were screened at Al-Manaqil Educational Hospital Blood Bank from September to December 2023. Hepatitis B surface antigen (HBsAg) was positive in 14 donors (overall prevalence 3.6%), all confirmed by both immunochromatographic test (ICT) and ELISA. The remaining 372 donors (96.4%) tested negative.

Prevalence by Diagnostic Tests

Table 1: HBV Prevalence by ICT and ELISA Confirmation (n=386)

ELISA Result	ICT Positive	ICT Negative	Total	Prevalence%
Positive	14	0	14	3.6
Negative	0	372	372	96.4
Total	14	372	386	100

χ^2 test: P=0.000 (significant)

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Demographic Characteristics

Table 2: HBV Status by Age Group (n=386)

Age group	Positive	Negative	Total	Prevalence%	RR	χ^2	P value
20-26	10	156	166	6.0	1.67	8.44	0.015
27-33	0	140	140	0.0	0		
34-40	4	76	80	5.0	1.39		
Total	14	372	386	3.6	1		

P<0.05 significant

Table 3: HBV Status by Occupation (n=386)

Occupation	Positive	Negative	Total	Prevalence%	RR	χ^2	P value
Healthcare worker	4	5	9	44.4	12.61	45.42	0.000
Farmer	1	41	42	2.4	0.66		
Driver	2	34	36	5.6	1.53		
Other employees	6	208	214	2.8	0.777		
Total	14	372	386	3.6	1		

Vaccination Status

Table 4: HBV Status by Vaccination History (n=386)

Vaccination	Positive	Negative	Total	Prevalence%	RR	χ^2	P value
Yes	1	74	75	1.3	0.36	1.604	0.449
No	13	298	311	4.2	1.17		
Total	14	372	386	3.6	1		

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Risk Factors

Table 5: Risk Factors Associated with HBV

Risk Factor	Positive	(negative)	Prevalence (%)	χ^2 P-value
Family history of HBV	6	16	27.3	0.000
Medical instrument injury	3	22	12.0	0.021

P<0.05 significant

Key Statistical Findings:

Overall HBV prevalence: 3.6%

Highest risk groups: Healthcare workers (44.4%, P=0.000), 20-26 years (6.0%, P=0.015)

Significant associations: Age (P=0.015), Occupation (P=0.000), Family history (P=0.000), Medical injuries (P=0.021)

Discussion:

The study revealed a hepatitis B virus (HBV) prevalence of 3.6% (14/386) among blood donors at Al-Manaqil Educational Hospital blood bank, Gezira State, Sudan. This rate aligns with regional findings, including 3.5% reported by(Elsharif et al. 2015) among donors at Kosti Teaching Hospital, White Nile State, Sudan, and 3.8% in Jazan, Saudi Arabia (Nagoor and Adetunji, 2021). However, it is lower than 7% prevalence documented by (Mohamed et al. 2022) in Algamosi Locality, Gezira State, possibly due to differences in donor screening practices or demographic profiles. Higher prevalence among healthcare workers (44.4%, P=0.000) underscores occupational risks, consistent with (Bakry et al. 2012) who found poor HBV vaccination coverage (>50% unvaccinated) and inadequate knowledge of universal precautions among Sudanese healthcare personnel. The 20-26 age group showed elevated rates (6.0%, P=0.015), supporting(Mohamed et al.,2022) who identified significant age-HBV

associations in central Sudan, likely reflecting behavioral factors such as multiple sexual partners or shared personal items (CDC, 2018).Risk factors including medical instrument injuries (12.0%, P=0.021) and family history (27.3%, P=0.000) confirm transmission routes emphasized by(IbnIdriss et al. 2022) in Sudanese communities. Unvaccinated donors had higher prevalence (4.2%), aligning with (WHO ,2015) evidence that vaccination reduces chronic HBV by >90% in immunized populations. Knowledge gaps (56-63% unaware of HBV transmission) mirror regional patterns (Bakry et al., 2012).

6. Conclusion

This study examined 386 blood donors attending the blood bank at Almanaqil Educational Hospital. The prevalence of hepatitis B virus (HBV) infection was 3.6% among participants. Significant associations were found between HBV positivity and several demographic factors, including:

Age: Highest prevalence in the 20-26 years group (6%; $P < 0.015$).

Occupation: Highest in medical workers (44.4%; $P < 0.001$).

Marital status: Highest among singles.

Education level: Highest among university-educated individuals.

Vaccination status: Highest among unvaccinated donors (4.2%).

Risk factors showed strong links, with elevated prevalence among those exposed to medical instrument injuries (12%; $P < 0.021$) and those with family members infected (30%; $P < 0.001$).

7.Recommendations

Enhance screening with more sensitive tests, such as nucleic acid testing (NAT), to minimize transmission risk.

Boost awareness campaigns educating potential donors on risk factors, promoting safe donation practices, and emphasizing HBV immunization for the public.

Develop robust blood bank policies, including stricter donor screening to exclude high-risk groups and ensure blood product safety.

Strengthen surveillance by monitoring donors with early disease signs and following up on positive cases. Promote mass HBV vaccination to lower community infection rates.

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