Bin-Hameed, E. et al, Yemeni J Med Sci. 2025; 19(2): 79 - 91
https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

OPEN ACCESS ORIGINAL ARTICLE

Seroprevalence and Risk Factors of Hepatitis B and C Viruses among Hemodialysis Patients in Mukalla City, Hadhramout, Yemen

Eidha Bin-Hameed[1,2*], Abdullah Macinon[1], Abdulrahman Hirsi[1], Afkar AL-gowaihi[1], Ahmed Alkharraz[1], Majdi Bares[1], Maroah Bin Mogheeth[1], Maryam Barakat[1], Nejood Ba weqad[1], Rahmah Bakran[1], Shaker Alkharraz [1]

[1] *Department of Health Sciences, Faculty of Medicine and Health Sciences, University of Science and Technology, Aden, Yemen*
[2] *Department of Biology, Faculty of Science, Hadhramout University, Yemen*

ABSTRACT

Introduction: Patients on hemodialysis are at high risk to infection by blood transfusion viruses, including the HBV and HCV. Hepatic failure, hepatocellular carcinoma, and liver cirrhosis can result from the persistent HBV and HCV infections.
Objective: The aim of the current study was to investigate the seroprevalence of HBV and HCV infection and study risk factors among HD patients in the Artificial Kidney Center at Mukalla city, Hadhramout.
Methods: A cross-sectional analytical study was carried out on 110 HD patients (73 males and 37 females) during the period from January to March 2024. Anti-HCV and HBsAg were identified using ECL assays. A designed questionnaire was used to collect data about risk factors, and SPSS software was used for analysis of data.
Results: Eight (7.3%) of the HD patients in our study had anti-HCV antibodies, while six (5.5%) had HBsAg. Age groups and educational levels were statistically significantly correlated with the prevalence rate of HBV (P=0.049) and (P=0.043) respectively. Analysis of other risk factors in HD patients with HBV and HCV infections of variables the blood transfusion during hemodialysis, previous operational surgery, number of hemodialysis more than 3 times per month, duration of hemodialysis 1-5 years, and unvaccinated patients against HBV don't showed any statistically significant associations.
Conclusion: HD patients in Hadhramout had lower prevalence rates of HBV and HCV infections. Strengthening infection control practices, expanding HBV vaccination coverage, enhancing patients, and staff education are crucial to further reduce the burden of hepatitis infections in dialysis centers.

Keywords: Seroprevalence, Risk Factors, Hepatitis B Virus, Hepatitis C Virus, Infections, Hemodialysis Patients

**** Corresponding author address:*** *e.binhameed@ust.edu, e.binhamiad@hu.edu.ye*

INTRODUCTION

Due to the possibility of developing hepatocellular carcinoma, liver cirrhosis, and chronic hepatitis, viral hepatitis is a serious worldwide public health concern (1, 2). Hepatitis B virus (HBV) and hepatitis C virus (HCV) attack and damage the liver. It is estimated that there are roughly 180 million people with HCV and 240 million people with chronic HBV infections worldwide, with 3–4 million new cases occurring each year for HBV infection (3).

The World Health Organization (WHO) reports that Yemen has an intermediate level of HBV infections (2%–7%) and HCV infections (2.5%–4.9%) (4). The most prevalent viruses linked to problems in patients receiving chronic hemodialysis (HD) are HBV and HCV (5). These two viruses cause infections that might start off as acute and progress to chronic, finally resulting to end-stage renal disease (ESRD), eventually to cirrhosis, hematologic illness and hepatocellular carcinoma (6, 7). For patients with ESRD, HD is the main treatment option (8). Over the past few decades, there has been a steady increase in the number of ESRD patients who need HD (9, 10).

HD is still the preferred renal replacement therapy for ESRD patients in low-income nations, despite the fact that renal transplantation improves quality of life and boosts survival rates when compared to HD (11). During the HD procedure, the patient's blood is drawn using needles and plastic tubing, and the blood is subsequently pumped into the dialysis membrane. Toxins and poisons enter the dialysate through the dialysis membrane, where they are eliminated before the patient receives their blood back (12). An elevated risk of parentally transmitted viruses, such as HBV and HCV, is linked to HD as an extracorporeal method (8). Thus, it's critical that dialysis facilities have sufficient procedures in place to avoid viral hepatitis infection, such as staff training and frequent audits (13). The health system in Yemen, one of the developing nations, is beset by structural and organizational flaws, a lack of personnel, poor healthcare quality, shortages of necessary medications, and unequal distribution of publicly funded facilities and human resources. In order to determine priorities for the health services, there is a continuous need for quantifiable data on the prevalence and possible risk factors that contribute to HBV and HCV infection in HD patients. So, the current study aimed to investigate the seroprevalence of HBV and HCV infection and study risk factors among HD patients in the Artificial Kidney Center at Mukalla city, Hadhramout.

SUBJECTS AND METHODS

Study Design, Period and Participants

A cross-sectional analytical study was conducted on HD patients attending the Artificial Kidney Center in Mukalla city, Hadhramout Governorate in the period from January to March 2024.

Sample Size, Inclusion and Exclusion Criteria

Convenience sampling (non-probability simple random sample) was used. So, the maximal participation could be ensured, that included 110 HD patients. Patients undergoing hemodialysis were included. Patients undergoing HD out of the Artificial Kidney Center at Mukalla city, and patients that are none undergoing hemodialysis were excluded.

Sample Collection and Processing for Detection of HBsAg and anti-HCV

Blood sample was collected from HD patients according to the kits of manufacturer's instructions. The electrochemiluminescence (ECL) immunoassay method was used to test the sera for hepatitis B surface antigen (HBsAg) and anti-HCV using a fully automated analyzer (Cobas e411) supplied by Roche Company, Germany.

Data Collection Tool

Data was collected from participants using a structure questionnaire after obtaining written informed consent. The questionnaire consisting sociodemographic and clinical characteristics such as gender, age, marital status, level of education, occupation, residence, duration of hemodialysis, number of hemodialysis in months, history of blood transfusion, blood transfusion during hemodialysis, surgery operation, family history of HBV and HCV infection, vaccination against HBV, history of diseases such as diabetic, heart diseases and hypertension.

Pre-test (Pilot of study)

Before data collection, the questionnaire was tested by selected participants to check understanding and its applicability. Based on the results obtained, some modifications were done on the questionnaire.

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

Ethical Considerations

The ethical approval of this study was obtained from the Ethics Committee at Faculty of Medicine and Health Sciences at University of Science and Technology, Hadhramout branch (No. 1/2024). The information was taken from the participants after they agreed to it verbally according to the informed consent with confidentiality of each study participant's result.

Data analysis

The Statistical Package for Social Sciences (SPSS), version 25 was used for data analysis. The frequencies and percentages of HBV and HCV infection were calculated. Independent predictors of the prevalence of HBV and HCV infection were found using binary and multiple regression tests (crude odds ratio COR/coefficient interval CI 95%). The level of statistical significance was set at *P-value* < 0.05.

RESULTS

A total of 110 patients were included in the study. Among them, 73(66.4%) were males and 37(33.6%) were females. The duration of dialysis was < 1 Year 8(7.3%) of the patients, 1-5 years 101(91.8%), and > 5 years 1(0.9%). Forty-three patients (39.1%) had previous surgery. In addition, 4(3.6%) and 1(0.9%) of the patients, previously had HBsAg and anti-HCV positivity respectively. Hypertension was the most common comorbidity which was found in 74(67.3%) of the patients followed by diabetic disease 25(22.7%). Some of the patients 24(21.8%) reported being vacci¬nated against HBV. A bout half of the patients 52(47.3%) have undergone blood transfusion. The HD sessions per months reported > 3 times and 1-3 times with 93(84.5%) and 17(15.5%) respectively (Table 1).

Table 1: General Characteristics of Study Population

Category	Characteristic	No. (%)
Sex	Male	73 (66.4)
	Female	37 (33.6)
Age group (years)	15-20 years	12 (10.9)
	21-30 years	15 (13.6)
	31-40 years	82 (74.5)
	41-80 years	1 (0.9)
Educational level	Illiterate	25 (22.7)
	Primary	41 (37.3)
	Secondary	33 (30.0)
	University	9 (8.2)
	Postgraduate	2 (1.8)
Marital Status	Married	95 (86.4)
	Divorced	2 (1.8)
	Widowed	1 (0.9)
	Single	12 (10.9)
Residence	Rural	15 (13.6)
	Urban	95 (86.4)
Occupation	Jobless	50 (45.5)
	Housewife	32 (29.1)
	Student	1 (0.9)
	Employed	27 (24.5)
Previous blood transfusion	Yes	52 (47.3)
	No	58 (52. 7)
Operation surgery	Yes	34 (30.9)
	No	76 (69.1)

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

Blood transfusion during hemodialysis	Yes	75 (68.2)
	No	35 (31.8)
Number of hemodialysis per month	>3 Times	93 (84.5)
	1-3 Times	17 (15.5)
Duration of hemodialysis	<1 Year	8 (7.3)
	1-5 Years	101 (91.8)
	>5 Years	1 (0.9)
Family history of HBV infection	Yes	4 (3.6)
	No	106 (96.4)
Family history of HCV infection	Yes	1(0.9)
	No	109 (99.1)
Vaccination against HBV before hemodialysis	Yes	21 (19.1)
	No	89 (80.9)
Vaccination against HBV during hemodialysis	Yes	3 (2.7)
	No	107 (97.3)
Diabetic	Yes	25 (22.7)
	No	85 (77.3)
Heart disease	Yes	6 (5.5)
	No	104 (94.5)
Hypertension	Yes	74 (67.3)
	No	36 (32.7)

Results of the screening of HBV and HCV are presented in Table (2). However, 6(5.5%) of HD patients were HBsAg positive and 8(7.3%) were anti-HCV positive.

Table 2: Seroprevalence of HBV and HCV among HD patients

Screen test	Positive results		Negative results	
	No.	%	No.	%
HBsAg	6	5.5	104	94.5
Anti-HCV	8	7.3	102	92.7

The results showed that the infection with HCV was observed in 9.6% of males and 2.7% of females. The age group of 21-30 years old had the greatest rate of HCV infection (13.3%), whereas the age group of 31-40 years old had the lowest frequency (7.3%). The greatest rate of HCV infection was 3.6% among jobless patients, followed by 2.7% among employed patients. Married individuals had the highest documented rate of HCV infection (4.5%), followed by single patients (2.7%). Also, the patients living in the urban area and primary school level showed the highest infections with HCV. HD patients infected HCV is showed association with blood transfusion during hemodialysis, previous surgery, number of hemodialysis more than 3 times per month, and duration of hemodialysis 1-5 years, Table (3).

Table 3: Variations in the Prevalence of HCV Infection in Hemodialysis Patients

Variable	No. of participant	Anti-HCV +ve		Anti-HCV -ve		CI (95%)	P-value
		No.	%	No.	%		
Sex							
Male	73	7	9.6	66	90.4	0.258-0.275	0.189
Female	37	1	2.7	36	97.3		
Age groups (years)							

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

15-20 years	12	0	0.0	12	100.0	0.496-0.515	0.610
21-30 years	15	2	13.3	13	86.7		
31-40 years	82	6	7.3	76	92.7		
41-80 years	1	0	0.0	1	100.0		
Educational level							
Illiterate	25	1	4.0	24	96.0	0.123-0.136	0.107
Primary	41	5	12.2	36	87.8		
Secondary	33	0	0.0	33	100.0		
University	9	2	22.2	7	77.8		
Postgraduate	2	0	0.0	2	100.0		
Marital status							
Married	95	5	5.3	90	94.7	0.179-0.195	0.094
Divorced	2	0	0.0	2	100.0		
Widowed	1	0	0.0	1	100.0		
Single	12	3	25.0	9	75.0		
Residence							
Rural	15	1	6.7	14	93.3	1.00-1.00	0.923
Urban	95	7	7.4	88	92.6		
Occupation							
Jobless	50	4	8.0	46	92.0	0.528-0.548	0.677
Housewife	32	1	3.1	31	96.9		
Student	1	0	0.0	1	100.0		
Employed	27	3	11.1	24	88.9		
Previous blood transfusion							
Yes	52	3	5.8	49	94.2	0.710-0.728	0.656
No	58	5	8.6	53	91.4		
Operation surgery							
Yes	34	5	14.7	29	85.3	0.284-0.265	0.159
No	76	3	3.9	73	96.1		
Blood transfusion during hemodialysis							
Yes	75	5	6.7	70	93.3	1.000-1.000	0.720
No	35	3	8.6	32	91.4		
Number of hemodialysis per month							
>3 Times	93	8	8.6	85	91.4	0.346-0.365	0.209
1-3 Times	17	0	0.0	17	100.0		
Duration of hemodialysis							
<1 Year	8	1	12.5	7	87.5	1.00-1.00	0.811
1-5 Years	101	7	6.9	94	93.1		
>5 Years	1	0	0.0	1	100.0		
Family history of HCV infection							
Yes	1	0	0.0	1	100.0	1.00-1.00	0.778
No	109	8	7.3	101	92.7		
Diabetic							
Yes	25	1	4.0	24	96.0	0.674-0.692	0.473
No	85	7	8.2	78	91.8		
Heart disease							
Yes	6	0	0.0	6	100.0	1.00-1.00	0.480

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

No	104	8	7.7	96	92.3		
Hypertension							
Yes	74	70	94.6	4	5.4	0.426-0.445	0.280
No	36	4	11.1	32	88.9		

The findings indicated that 0.9% of females and 4.5% of males had HBV infection. The highest prevalence of HBV infection 2.7% was found in the 31–40 age group, while the lowest prevalence 1.8% was found in the age group of 41-80 years old. Patients without jobs had the greatest HBV infection rate (2.7%), followed by those with jobs (1.8%). Married individuals had the greatest documented rate of HBV infection (3.6%), followed by single patients (1.8%). Additionally, patients who were enrolled in elementary school and lived in metropolitan areas had the highest rates of HBV infection. Age groups and educational level were statistically significantly correlated with the prevalence of HBV (P=0.049 and 0.043) respectively, Table (4).

Table 4: Variations in the Prevalence of HBV Infection in Hemodialysis Patients

Variable	**No. of participant**	**HBsAg +ve**		**HBsAg -ve**		**CI (95%)**	**P-value**
		No.	%	No.	%		
Sex							
Male	73	5	6.8	68	93.2	0.421-0.441	0.366
Female	37	1	2.7	36	97.3		
Age groups (years)							
15-20 years	12	0	0.0	12	100.0	0.77-0.88	0.049*
21-30 years	15	2	13.3	13	86.7		
31-40 years	82	4	4.9	78	95.1		
41-80 years	1	0	0.0	1	100.0		
Educational level							
Illiterate	25	0	0.0	25	100.0	0.165-0.180	0.043*
Primary	41	4	9.8	37	90.2		
Secondary	33	0	0.0	33	100.0		
University	9	2	22.2	7	77.8		
Postgraduate	2	0	0.0	2	100.0		
Marital status							
Married	95	4	4.2	91	95.8	0.267-0.285	0.336
Divorced	2	0	0.0	2	100.0		
Widowed	1	0	0.0	1	100.0		
Single	12	2	16.7	10	83.3		
Residence							
Rural	15	1	6.7	14	93.3	1.000	0.824
Urban	95	5	5.3	90	94.7		
Occupation							
Jobless	50	3	6.0	47	94.0	0.771-0.788	0.891
Housewife	32	1	3.1	31	96.9		
Student	1	0	0.0	1	100.0		
Employed	27	2	7.4	25	92.6		
Previous blood transfusion							
Yes	52	1	1.9	51	98.1	0.201-0.217	0.123
No	58	5	8.6	53	91.4		

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

Operation surgery							
Yes	34	3	8.8	31	91.2	0.666-0.684	0.573
No	76	3	3.9	73	96.1		
Blood transfusion during hemodialysis							
Yes	75	4	5.3	71	94.7	1.000-1.000	0.935
No	35	2	5.7	33	94.3		
Number of hemodialysis per month							
>3 Times	93	6	6.5	87	93.5	0.574-0.593	0.281
1-3 Times	17	0	0.0	17	100.0		
Duration of hemodialysis							
<1 Year	8	0	0.0	8	100.0	1.00-1.00	0.754
1-5 Years	101	6	5.9	95	94.1		
>5 Years	1	1	100.0	0	0.0		
Family history of HBV infection							
Yes	4	0	0.0	4	100.0	1.00-1.00	0.625
No	106	6	5.7	100	94.3		
Vaccination against HBV before hemodialysis							
Yes	21	0	0.0	21	100.0	0.338-0.356	0.221
No	89	6	6.7	83	93.3		
Vaccination against HBV during hemodialysis							
Yes	3	0	0.0	3	100.0	1.00-1.00	0.637
No	107	6	5.6	101	94.4		
Diabetic							
Yes	25	2	8.0	23	92.0	0.611-0.630	0.524
No	85	4	4.7	81	95.3		
Heart disease							
Yes	6	0	0.0	6	100.0	1.00-1.00	0.545
No	104	6	5.8	98	94.2		
Hypertension							
Yes	74	4	5.4	70	94.6	1.00-1.00	0.974
No	36	2	5.6	34	94.4		

For both HBV and HCV, logistic regression models were used to account for potential confounding variables (Table 5). Patients who receive HD for longer periods of time and for more than three sessions are more likely to contract viral hepatitis, according to an analysis of risk factors in HD patients with HBV and HCV infections. Compared to patients who received the vaccination, HD patients who did not get the HBV vaccine had a higher risk of contracting HBV. Additionally, it was discovered that patients with a history of prior operative surgery or blood transfusions during hemodialysis had a higher chance of testing positive for viral hepatitis than other patients.

Table 5: Binomial logistic regression model analysis for positive anti-HCV and HBsAg

Variable	**Positive HBsAg**			**Positive anti-HCV**		
	Odd ratio	CI (95%)	P-value	Odd ratio	CI (95%)	P-value
Sex						

https://doi.org/10.20428/yjms.v19i2.2627
https://journals.ust.edu/index.php/yjms

Male	2.647	0.298-23.527	0.382	3.818	0.452-32.267	0.219
Female	-	-	-	-	-	-
Age groups (years)						
15-20 years	-	-	-	-	-	-
21-30 years	146860668.600	0.00	1.00	323093749.2	0.00	1.000
31-40 years	403866838.700	0.00	1.00	115390624.7	0.00	1.000
40-80 years	40386683.870	0.00	1.00	104900567.9	0.00	1.000
Previous blood transfusion						
Yes	0.792	0.023-1.841	0.158	0.351	0.147-2.860	0.568
No	-	-	-	-	-	-
Operational surgery						
Yes	1.600	0.308-8.317	0.576	2.807	0.635-12.412	0.174
No	-	-	-	-	-	-
Blood transfusion during hemodialysis						
Yes	0.07	0.162-5.333	0.935	0.238	0.172-3.385	0.721
No	-	-	-	-	-	-
Number of hemodialysis per month						
>3 Times	111412050.1	0.000	0.998	152044673.8	0.000	0.998
1-3 Times	-	-	-	-	-	-
Duration of hemodialysis						
>5 Years	1.000	0.000	1.00	1.00	0.000	1.00
1-5 Years	102029987.5	0.000	1.00	0.479	0.056-4.855	0.567
<1 Year	-	-	-	-	-	
Family history of hepatitis B infection						
Yes	1.000	0.000	0.999	-	-	-
No	-	-	-	-	-	-
Famil history of hepatitis C infection						
Yes	-	-	-	1.000	0.000	0.999
No	-	-	-	-	-	-
Vaccination against hepatitis B before hemodialysis						
Yes	1.000	0.000	0.998			
No	-	-	-			
Vaccination against hepatitis B during hemodialysis						
Yes	1.000	0.000	0.999			
No	-	-	-			

DISCUSSION

There was no any published data concerned the seroprevalence of HBV and HCV infections among HD patients in Hadhramout Governorate Yemen. The current study demonstrated that the prevalence of HBsAg and anti-HCV were 5.5% and 7.3% among HD patients, respectively. According to the literature, there are notable differences in the prevalence of HBsAg and anti-HCV among HD patients amongst nations and regions of the world (14). According to reports, HD patients in industrialized and developing nations had anti-HCV prevalence of 1.4–28.3% and 4.7–41.9%, respectively (14).

Our results are similar to previous studies from other developing Arab countries where the prevalence of HBsAg and anti-HCV such as (5.5% and 7.3%) in Tunisia (5), (6.53% and 10.36%) in Yemen (15), (3.2%, and 22.1%) in Syria (16). In Sudan, approximately 20.9% of all HD patients had anti-HCV infection (17). However, compared to other countries like Lebanon (1.6%/4.7%) (18) and Iraq (3.2%/3.4%), our study's prevalence of HBsAg and anti-HCV were greater than that recorded in Iraq (3.2% and 3.4%) (19), Nigeria (2.98% and 1.19%) (20), Palestine (3.8% and 7.4%) (21), Turkey (1% and 3.1%) (22), Iran (0.09% and 0.18%) (23), India (2.17% and 1.38%) (24), and Ethiopia (1.2% and2.8%) (25).

On contrary, our results showed lower prevalence of HBsAg and anti-HCV than other developing countries, (8% and 4%) in Pakistan (26), (11.0% and 23.9%) in Argentina (27), (9.88% and 23.04%) in Africa (8), (13.8% and 4.6%) in Iran (28), (11.7% and 23%) in Pakistan (29), HBsAg was 45% and 53% in Sudan (30) and Kosovo (31) respectively.

It is important to note that the prevalence of HBsAg/anti-HCV among HD patients in Hadhramout Governorate has significantly decreased, according to the current data. The strict implementation of infection control and successful international efforts to stop the spread of blood-transmitted viruses, the variations in local prevalence rates, and the configurations of each nation's healthcare systems could all be factors in the disparity in prevalence rates among these nations (32, 33).

It is evidently attributable to an improvement in clinical procedures, including improved patient monitoring and the use of virus identification tests that have become more precise, sensitive, and specific. Strict adherence requirements that are in line with international recommendations for the prevention and control of viral infections that spread among HD patients must constantly be established (34). Age groups and educational level were the only variables that were substantially linked to the prevalence of HBsAg. After adjusting for other factors, it was discovered that HD patients who were not vaccinated were more likely to contract HBV than those who were. In certain nations, HD patients have consistently reported that the HBV vaccine is an effective preventive measure against acquiring an HBV infection (35, 36). This also explains why our study's HBV prevalence rate was lower than that of HCV.

A history of blood transfusions is one of the other predictors of positive HBV that have been documented in the literature (37, 38). Additionally, the number and length of hemodialysis sessions as well as a family history of HBV infection were identified in our study as contributing variables to the prevalence of HBV and HCV in HD patients. Nevertheless, further research supports our findings, showing that none of these variables were significant predictors (35) (38, 39). Another study revealed that seroconversion for both the hepatitis B and C viruses was unrelated to the length of hemodialysis, history of invasive procedures, HIV status, frequency of hospitalization, and blood transfusion (20).

Longer hemodialysis duration was associated with a higher risk of HCV infection, according to the current investigation on the prevalence of HCV infection. Several studies throughout the world have revealed similar findings (36) (38). Given that epidemiological and molecular investigations have demonstrated the significance of environmental dialysis in the spread of HCV infection among HD patients, the effect of hemodialysis duration is compatible with the nosocomial transmission of HCV infection. This correlation might result from the intrusive nature of dialysis, which necessitates frequent and extended access to blood vessels and exposes patients to potentially contaminated equipment shared by HCV-infected patients who do not follow transmission prevention protocols (32).

The main causes of HD patients' increased risk of acquiring healthcare-associated infections (HAIs) are:

- immunocompromised status,
- frequent and prolonged blood exposure during HD treatments through the vascular access and extracorporeal circuit with numerous ports and connections,
- close proximity to other patients during treatment in the HD facility,
- frequent contact with healthcare workers who frequently move between patients and machines,
- frequent hospital stays and surgeries,
- non-adherence or a break in implementation of recommended practices, including hand

hygiene and use of personal protective equipment (40).

Furthermore, there was no routine audit on the compliance of the staff with the nosocomial infection control guidelines in the local study center. In actuality, a thorough evaluation of HD centers is essential, particularly for those with high HBV or HCV prevalence. Similar results were previously reported from Lebanon (18) and Syria (16). The frequency of HCV in our student patients was not substantially correlated with other risk factors identified by prior research, such as history of blood transfusions (38), or history of surgery (16).

Nonetheless, there are significant national differences in the risk factors for HCV infection in HD patients. Several other studies agree with our results as none of the above factors were significant predictors of HCV contamination among their HD patients (41) (35). The degree of adherence to the established infection prevention strategies and the new techniques or technologies employed could be the primary cause of the discrepancy in the outcomes (41). The majority of HD patients who receive dialysis for extended periods of time are subject to the different side effects that can arise from the process. Viral hepatitis is typically nosocomial in terms of transmission to HD patients. Long-term vascular exposure, multiple blood transfusions, sharing single-use infusion vials, inadequate aseptic procedures, contaminated dialysis equipment and supplies, and contamination by attending staff are some of the potential risk factors (39). Additionally, HD patients already have impaired immune systems because of irreversible renal damage, which makes them more vulnerable to viral infection (42).

Demographic factors such as age, gender, and marital status did not significantly distinguish between HBV and HCV cases. Some independent risk factors for the spread of viral hepatitis infections include, for example, having a family history of hepatitis, having seen a dentist in the past, having undergone traditional medical procedures, and not knowing that hepatitis is spread through sexual contact (43). However, the adoption of modern guidelines that require blood screening for donors and the application of stringent cleaning and hygiene measures for operating rooms, equipment, and staff has significantly decreased this danger (44-47). This study has several limitations; the cross-sectional study design limits the ability to reveal a true association between HD patients and HBV and HCV infections due small sample size, convenience sampling, reliance on self-reported data, and the prevalence of HBsAg and anti-HCV could not be representative the general population in HD centers.

CONCLUSION

Despite a decline in HBV and HCV prevalence among HD patients, the rates remain a significant concern. Strengthening infection control practices, expanding HBV vaccination coverage, enhancing patients, and staff education are crucial to further reduce the burden of hepatitis infections in dialysis centers.

Conflict of Interest

The authors of this article declare that they have no conflict of interest.

Acknowledgments

The authors would like to extend their warmest thanks to the staff and HD patients of the Artificial Kidney Center in Mukalla city, Hadhramout Governorate for their valuable efforts to provide the authors with the required data and samples collection.

REFERENCES

[1] Obeagu EI, Obeagu GU, Nwosu DC. Hepatitis B and Hepatitis C viral infection: A review. *Int J Curr Res Chem Pharm Sci.* 2016;3(11):10-21. DOI:10.22192/ijcrcps.

[2] Almeida PH, Matielo CE, Curvelo LA, et al. Update on the management and treatment of viral hepatitis. *Int J Curr Res Chem Pharm Sci.* 2021;27(23):3249-61. DOI:10.3748/wjg.v27.i23.3249.

[3] Irfan M, Anwer Z, Naveed M, et al. HCV genotypes and risk factors; Current scenario in Pakistan. *Philipp Soc Microbiol.* 2016;01(S1):S1-S5.

[4] Almezgagi MM, Edrees WH, Al-Shehari WA, et al. Prevalence of hepatitis B virus and hepatitis C virus and associated risk factors among hemodialysis patients in Ibb city-Yemen. *Philipp Soc Microbiol.* 2020;5:32-40.

[5] Mhalla S, Hammoud R, Frih B, et al. Prevalence and risk factors of hepatitis B and C among hemodialysis patients in Tunisia. *Med Mal Infect.* 2018;48(3):175-9. DOI:10.1016/j.medmal.2017.11.006.

[6] Ali HM, Bhatti S, Iqbal MN, et al. Mutational analysis of MDM2 gene in hepatocellular carcinoma. *Sci Lett.* 2015;3(1):33-6.

[7] Hussien M, Zahran F, El-Emshaty H, et al. Diagnostic value of fibrotic indices in Egyptian patients with chronic hepatitis and hepatocellular carcinoma. *Philipp Soc Biol Res.* 2018;3(1):9-15.

[8] Rekha RK, Ghanshyam UK, Twinklekumar P, et al. Studying the prevalence of hepatitis B and hepatitis C virus infection along with its associated risk factors in hemodialysis patients. *J Acad Med Pharm.* 2023;5(3):255-60. DOI:10.47009/jamp.2023.5.3.5.

[9] Gaipov A, Issanov A, Kadyrzhanuly K, et al. Epidemiology of dialysis-treated end-stage renal disease patients in Kazakhstan: data from nationwide large-scale registry 2014–2018. *Biomed Cent Nephrol.* 2020;21(1):1-9. DOI:10.1186/s12882-020-02047-6.

[10] Choi HS, Han KD, Oh TR, et al. Trends in the incidence and prevalence of end-stage renal disease with hemodialysis in entire Korean population: a nationwide population-based study. *Medicine.* 2021;100(13):e25333.

[11] Wong G, Howard K, Chapman JR, et al. Comparative survival and economic benefits of deceased donor kidney transplantation and dialysis in people with varying ages and co-morbidities. *PLoS One.* 2012;7(1):e29591. DOI:10.1371/journal.pone.0029591.

[12] Nissenson AR, Fine RE. *Handbook of Dialysis Therapy.* Amsterdam, Netherlands: Elsevier Health Sciences; 2016.

[13] Jadoul M, Bieber BA, Martin P, et al. Prevalence incidence and risk factors for hepatitis C virus infection in hemodialysis patients. *Kidney Int.* 2019;95:939.

[14] Fabrizi F, Messa P. The epidemiology of HCV infection in patients with advanced CKD/ESRD: A global perspective. *Semin Dial.* 2019;32:93-8. DOI:10.1111/sdi.12757.

[15] Al-Shahethi AH, Al-Shameri FMEA, Al-Shahethi HM, et al. Epidemiology of hepatitis B & C virus infections among hemodialysis patients: A cross-sectional survey in five hemodialysis centers in Yemen. *Al-Razi Univ J Med Sci.* 2023;7(1):70-7.

[16] Altinawe J, Akkawi ME, Helu NK, et al. Seroprevalence and risk factors of HBV, HCV, and HIV among hemodialysis patients: a multicenter cross-sectional study from Damascus, Syria. *BMC Infect Dis.* 2024;24:289. DOI: https://doi.org/10.1186/s12879-024-09177-4.

[17] Abdalla EAM, Shaaban KMA, Elkhidir IM. Prevalence and risk factors of HCV infection among hemodialysis patients at dialysis centers in Khartoum State - Sudan. *IOSR J Dent Med Sci.* 2017;16:83–8.

[18] Rached A, ElKhoury L, El Imad T, et al. Incidence and prevalence of hepatitis B and hepatitis C viruses in hemodialysis patients in Lebanon. *World J Nephrol.* 2016;5(1):101-7. DOI: 10.5527/wjn.v5.i1.101.

[19] Ibrahim NMR, Sidiq Z, Saleem M, et al. The prevalence of HIV, HCV, and HBV among hemodialysis patients attending Duhok Hemodialysis Center. *Int J Infect.* 2018;5(1):63246. DOI: https://brieflands.com/articles/iji-63246.html.

[20] Mahupe P, Molefe-Baikai OJ, Saleshando G, et al. Prevalence and risk factors for hepatitis B and C among end-stage renal disease patients on hemodialysis in Gaborone, Botswana. *Niger J Clin Pract.* 2021;24(1):81-8. DOI: 10.4103/njcp-464-19.

[21] Al Zabadi H, Rahal H, Fuqaha R. Hepatitis B and C prevalence among hemodialysis patients in the West Bank hospitals, Palestine. *BMC Infect Dis.* 2016;16:1–5. DOI: https://doi.org/10.1186/s12879-016-1359-8.

[22] Ergen P, Aydın O, Erbakan AN, et al. Overview of blood-borne viral infections in hemodialysis patients: hepatitis B, hepatitis C, human immunodeficiency virus infections. *J Health Sci Med.* 2022;5(1):195-200. DOI: 10.32322/jhsm.991215.

[23] Shamsdin SA, Fatahi MR, Ansari AR, et al. Prevalence of HBV, HCV, and HIV infections among patients undergoing hemodialysis in Fasa, Iran: a six-year follow-up study. *Middle East J Dig Dis.* 2022;14(3):317-22. DOI: 10.34172/mejdd.2022.289.

[24] Jamil MD, Bhattacharya PK, Yunus MD, et al. Prevalence of hepatitis B and hepatitis C in haemodialysis population in a tertiary care center in north-eastern India. *Int J Biomed Adv Res.* 2016;7(6):267-9. DOI: 10.7439/ijbar.

[25] Juhar SK, Nurahmed N, Kebede S, et al. Prevalence of hepatitis B and C viruses infections among hemodialysis patients in Addis Ababa, Ethiopia. *J Interv Nephrol.* 2018;1(1):08–14. DOI: 10.4172/J.IntervNephrol.1000102.

[26] Baig MA, Ansari TA, Mugheri A, et al. Determine the frequency of hepatitis B and C in patients undergoing hemodialysis. *Pak J Med Health Sci.* 2022;16:1-30. DOI: https://doi.org/10.53350/pjmhs22162130.

[27] Matías J, Alfredo P, Martins KI, et al. Prevalence of hepatitis B, hepatitis C, and HIV infection among patients undergoing hemodialysis in Argentina. *J Med Microbiol.* 2020. DOI: https://doi.org/10.1101/2020.08.04.20168385 .

[28] Khorrami MB, Amali A, Sadeghi M, et al. The prevalence of HBV, HCV, and HIV among hemodialysis patients in a tertiary care hospital in Mashhad, Iran. *J Infect Dev Ctries.* 2023;17(8):1146-51. DOI: 10.3855/jidc.16874.

[29] Habbir U, Hassan W, Raza A, et al. Seroprevalence of hepatitis B virus and hepatitis C virus in patients undergoing maintenance hemodialysis. *Cureus.* 2022;14(5):e24794. DOI: 10.7759/cureus.24794.

[30] Adam M, Siddig I, Omer S, et al. Serodiagnosis of hepatitis B surface antigen and anti-hepatitis C virus among hemodialysis patients in Khartoum State, Sudan. *SAR J Pathol Microbiol.* 2024;5:13-8. DOI: 10.36346/sarjpm.2024.v05i01.003.

[31] Jakupi X, Mlakar J, Lunar MM, et al. A very high prevalence of hepatitis C virus infection among patients undergoing hemodialysis in Kosovo: a nationwide study. *BMC Nephrol.* 2018;19:1-8. DOI: https://doi.org/10.1186/s12882-018-1100-5.

[32] Timofte D, Dragos D, Balcangiu-Stroescu AE, et al. Infection with hepatitis C virus in hemodialysis patients: an overview of the diagnosis and prevention rules within a hemodialysis center (review). *Exp Ther Med.* 2020;20:109-16. DOI: 10.3892/etm.2020.8606.

[33] Noubiap JJN, Joko WAY, Nansseu JRN, et al. Sero-epidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon. *Int J Infect Dis.* 2013;17.

[34] Elamin S, Abu-Aisha H. Prevention of hepatitis B virus and hepatitis C virus transmission in hemodialysis centers: review of current international recommendations. *Arab J Nephrol Transplant.* 2011;4:35-47. DOI: https://www.ajol.info/index.php/ajnt/article/view/63154.

[35] Assi WT, Moualla N, Ibrahim AI. Prevalence of hepatitis B virus (HBV) and hepatitis C virus (HCV) infection among hemodialysis (HD) patients in Aleppo city, Syria. *Res J Pharm Technol.* 2017;10:1301-4.

[36] Sinjari HYA, Bakr KA. Prevalence and risk factors of hepatitis B and C virus infections among patients undergoing hemodialysis in Kurdistan, Iraq. *Hepat Mon.* 2018;18:11776. DOI: 10.5812/hepatmon.11776.

[37] El-Ottol AEKY, Elmanama AA, Ayesh BM. Prevalence and risk factors of hepatitis B and C viruses among haemodialysis patients in Gaza Strip, Palestine. *Virol J.* 2010;7:1-7. DOI: https://doi.org/10.1186/1743-422X-7-210.

[38] Jeele MOO, Addow ROB, Adan FN, et al. Prevalence and risk factors associated with hepatitis B and hepatitis C infections among patients undergoing hemodialysis: a single-centre study in Somalia. *Int J Nephrol.* 2021. DOI: https://doi.org/10.1155/2021/1555775.

[39] Adane T, Getawa S. The prevalence and associated factors of hepatitis B and C virus in hemodialysis patients in Africa: a systematic review and meta-analysis. *PLoS One.* 2021;16(6):e0251570. DOI: https://doi.org/10.1371/journal.pone.0251570

[40] Karkar A. Hand hygiene in haemodialysis units. *Open Access Libr J.* 2016;3:e2953. DOI: http://dx.doi.org/10.4236/oalib.1102953.

[41] Halle MP, Choukem SP, Kaze FF, et al. Hepatitis C and human immune deficiency virus seroconversion positivity rates and their potential risk factors among patients on maintenance hemodialysis in Cameroon. *Iran J Kidney Dis.* 2016;10:304-9.

[42] Schaier M, Leick A, Uhlmann L, et al. End-stage renal disease, dialysis, kidney transplantation and their impact on CD4(+) T-cell differentiation. *Immunology.* 2018;155:211-24.

[43] Weldebrhan D, Berhe H, Tesfay Y. Risk factors for hepatitis B virus infection in North Ethiopia: a case-control study. *Hepat Med Evid Res.* 2023;15:79-91. DOI: https://doi.org/10.2147/HMER.S407069.

[44] Dahl V, Majeed A, Wikman A, et al. Transmission of viral hepatitis through blood transfusion in Sweden, 1968 to 2012. *Eurosurveillance.* 2020;25:1-9. DOI: https://doi.org/10.2807/1560-7917.ES.2020.25.29.1900537.

[45] Henriot P, Castry M, Luong Nguyen LB, et al. Meta-analysis: risk of hepatitis C virus infection associated with hospital-based invasive procedures. *Aliment Pharmacol Ther.* 2022;56:558-69. DOI: https://doi.org/10.1111/apt.17106.

[46] Gubran AN, AL-Ariqi AA, Hashem AR, Garadah EM, AL-Yafaee FN, Ba-Wazer SS, Mohame'd A BN, Tanbash MM. Hepatitis B virus infection among hemodialysis patients in Aden-Yemen. Yemeni Journal for Medical Sciences. 2024 Nov 1;18(1):1-8.

[47] Hudna AS, Salah AA, Almaqrami AA, Senan AF, Berman FA, Ali IM, Al-Khalqi MA, Al-Shoaibi OH, Ali WM, Al-Arashani YA. Hepatitis B and C among Multi-Transfused Pediatric Thalassemic Patients in Sana'a City, Yemen: A Single-Center Retrospective Study. Yemeni Journal for Medical Sciences. 2022 Dec 27;16(1):7-13.