

Seroprevalence of Hepatitis C, Hepatitis B, and HIV Infections among Hemodialysis Patients in Al-Diwanyah, Iraq

Mohammed Abdulkadhim Sayah *¹, and Abbas Ghafil Abbas ²

^{1,2}Department of Anatomy, College of Medicine, University of Al-Qadisiyah- Al Diwanyah, Iraq.

*Corresponding Author Email: mohammed.abdulkadhim@qu.edu.iq

ABSTRACT

Background: The blood -borne infections such as Hepatitis B (HBV), Hepatitis C (HCV), and Human immunodeficiency virus (HIV) are the most important and significant causes of serious chronic illnesses in patients with end stage of renal disease that undergo long-term hemodialysis sessions. The frequency of hepatitis viral infections amongst hemodialysis patients is relatively elevated and differs among different countries and also among dialysis centers into the same country. **Method:** During 2024, a cross-sectional study was achieved in Al-Diwanyah province in Iraq, among 275 HD patients from hemodialysis centers of Al-Diwanyah teaching hospital. All positive cases were screened for Hepatitis B surface Ag (HBs-Ag), Hepatitis C virus Ab (HCVAb) and HIV antibody (HIV-Ab), using specific enzyme-linked immunoassay (Elisa technique). **Result:** The total number of patients attended for receiving hemodialysis services throughout the study period was 275. Only 40/275(14.5%) was positive for hepatitis infections (HBV,HCV or both). Among these, only 7/275(2.5%) patients appeared positive for HBV, 25/275(9%) patients appeared positive for HCV, and 8/275(2.9%) were positive for co-infections of HCV and HBV, while, there was no infection with HIV. Mean of the age of infected patients in present study appeared 39.3 years. The infections were concentrated in males with 29/40(72.5%) more than females 11/40(27.5%). While, infections were concentrated in rural areas with 27/40(67.5%) more than urban areas 13/40(37.5%). Mean of the duration of dialysis courses for positive cases was 3.6 hours and mean of dialysis intervals was three time a week. **Conclusion:** Adherence to health and preventive standards for kidney dialysis centers to prevent the spread of viral infections among patients is an essential factor in protecting them from the risks of such infections and its long-term complications, which are considered life threatening in the foreseeable future.

Keywords: Sick Cell Anemia, Iron Overload, Renal Function Tests, Ferritin.

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INTRODUCTION

Hemodialysis (HD) operation is considered as one of the most common types of treatment for patients that suffered from advanced kidney failure, as this method is widely used to treat approximately (2760000) patients worldwide (1). HD is used as a first step to partially compensate of lost kidney functions, especially in patients who have developed a serious chronic stage of the disease, which is known as end-stage renal disease (ESRD)(2). Principle of HD process based on removing of excess water and toxic substances that accumulated into blood of patients. This type of

treatment could be replaced by a kidney transplant or may last a lifetime (3,4). The average use of HD process for each patient is three sessions per week, each session lasting about four hours. This process usually requires hospitalization for long periods (4). HD subjected individual are at a great risk of blood transmissible viruses such as (HBV, HCV, HIV) due to many practices that could occur periodically during undergo to multiple HD sessions, such as the transmission of viral contaminated blood from infected patients to another as a result of using the same medical devices, invasive procedures, long

term dialysis periods. Besides, general weak immunity and the weak response of such patients to HBV vaccine or medications that used regularly may increase their risk of developing such infections. (5,6,7).

In addition to this, what increases the risks is increasing numbers of HBV infections worldwide which estimated around 300 million patients with 1 million deaths annually (8). While, the number of people infected with the HCV was 58 million viruses globally and the number of annual new infections is 1.5 million. On other hand the number of HIV patient is 39 million worldwide with 290,000 patients' death annually (9,11,12). Accordingly, there are great fears that such infections could spread to this group remarkably.

As a result, Infection with hepatitis viruses leads to an increase in morbidity and mortality in HD subjected patients due to a immunocompromising and worsens the patient's health condition through inducing liver damage which can leads to liver cirrhosis and hepatocellular carcinoma(13,14), especially in HCV-infected patients which increased five-fold among these patients (15).On other side, infection with HIV virus induces many infections, such as pulmonary tuberculosis, septicemia, drug poisoning, and cardiovascular and respiratory disorders which associated usually with long hospitalization or admission of patients to intensive care unit (ICU)(16)

Therefore, such infections and complications that are mentioned previously are life threatening, as they result in clear resistance to interferon treatment especially with coinfections, thus making it difficult to remove viruses from the body effectively (17).

The present study aims to investigate the frequency of (HBV, HCV, coinfections, and HIV) infections in the hemodialysis subjected group and the risky factors that could be related with such infections.

METHODS

This cross-sectional study was achieved in the dialysis center of Al-Diwaniyah province in Iraq,in teaching hospital during the period from (1 February to 1 August of the 2024). It included patients (275) within the age range of (10- > 65 years) that suffered from chronic renal failure and were receiving regular HD treatment in this center. Samples were taken from the patient and subjected to serological tests, Hepatitis B surface antigens

(HBsAg), anti-HCV antibodies (anti-HCV Ab) and anti-HIV antibody were measured by Elisa technique. Patients' clinical forma were revised to acquire information like types of infection, age, clinical diagnosis, gender, duration and numbers of dialysis, histories of blood transfusions, these details were collected in a pre-performed questionnaire for all cases.

Statistical analysis

SPSS version (20) was utilized for statistical analysis of data. Nonparametric tests and chi-square tests were utilized for comparing of positive cases variables. The P-value ($P < 0.05$) considered to be statistically significant.

RESULTS

The present retrospective study was performed during period that extended from (January to August 2024). Overall of 275 patients were identified with chronic kidney illness and they continued hemodialysis treatment during the study duration.

Among these patients, 40/275 cases (14.5%) were showed to be infected with either HCV or HBV. While, there is no infection with HIV in the present study. Out of 40 positive cases that studied, 7/275 (2.5%) tested positive for HBsAg, 25/275 (9%) tested positive for Anti-HCV antibodies and 8/275 (2.9%) were positive for co-infection of both of HBsAg and Anti-HCV antibodies. Accordingly, percentage of HCV positive cases was higher than HBV and co-infection together. There was no a statistically significant difference at ($P < 0.05$) with (95% CI 79.4%-92.2%) among the cases with respect to types of viral infections. As shown on **Table no (1)**.

Also, according to gender, the present study revealed that out of 25/40 cases infected with HCV, 17/25(68%) were males and 8/25(32%) were females, among total of seven HBV positive cases, 4/7(57%) were males and 3/7(43%) were female and among duo infection with HCV and HBV that were 8 patients, 5/8(62.5%) were male and 3/8(37.5%) were female. There was no a statistically significant difference at ($P < 0.05$) among the cases concerning gender. As shown in **Table no (2)**. Besides, according to age, mean of the age of the positive cases in this study was 39.3 years. HBV and HCV infections were observed most frequently in the age group of 45–64 years. Whilst, co-infections (HCV,

HBV) were most frequent in the age group of 20–44 years. As shown in **Table no (3)**.

Moreover, with regarded to residency, this study showed the total numbers of positive patients of hepatitis were higher in rural area 27/40(67.5%) in comparable to urban area 13/40(32.5%). It was no a significant statistically difference at ($P < 0.05$) among the cases concerning to residency. As appear in **Table no (4)** . With regarded to number and duration of dialysis sessions, the present study showed the numbers of hepatitis positive patients

were higher in the group that supplied with three-times sessions per-week which showed 38/40(95%) than group with two-times per-week which showed 2/40(5%), whereas, according to duration of dialysis, the number of positive patient that undergo four hours per-session were 26/40 (65%) which higher than three-hours patients that showed 11/40 (27.5%) and two-hours group that showed 4/40 (1%). There was a significant statistically difference at ($P < 0.05$) among the cases concerning to duration and number of sessions. As shown in **Table no (5)**.

Table (1): Distribution of viruses among patients' group.

Types of viruses	Positive No	Negative No	Positive percentage %	P -value	Confidant interval-CI
HCV -only	25	250	25/275(9%)	0.07	1.95-1.97
HBV-only	7	268	7/275(2.5%)	0.5	
HBV, HCV -co	8	277	8/275(2.9%)	0.06	
HIV	0	0%	0/275(0%)	-	
Total	40/40(100%)	11/40(27.5%)	40/275(14.5%)		

Table (2): Distribution of positive cases among patients' group according to gender.

Types of viruses	Males No. %	Females No. %	P -value
HCV	17/25(68%)	8/25(32%)	0.08
HBV	4/7(57%)	3/7(43%)	
HBV, HCV	5/8(62.5%)	3/8(37.5%)	
HIV	0%	0%	
Total	29/40(72.5%)	11/40(27.5%)	

Table (3): Distribution of positive cases among patients' group according to age.

Age of patients	HCV	HBV	HCV, HBV	HIV
10-19	0/25(0%)	0/7(0%)	1/8(12.5%)	0%
20-44	9/25(36%)	3/7(43%)	4/8(50%)	-
45-64	13/25(52%)	4/7(57%)	3/8(37.5%)	-
65-	3/25(12%)	0/7(0%)	0/8(0%)	
Total	25	7	8	0

Table (4): Distribution of positive cases among patients' group according to residency.

Types of viruses	Urban	Rural	P -value
HCV	8/25(32%)	17/25(68%)	0.7
HBV	2/7(39%)	5/7(71%)	
HBV, HCV	3/8(37.5%)	5/8(62.5%)	
HIV	0%	0%	
Total	13/40(32.5%)	27/40(67.5%)	

Table (5): Distribution of positive cases among patients' group according duration of HD.

Sessions of dialysis	Patients no.	Percentage	P-value
Per-week			
3-times	38/40	95%	0.00
2-times	2/40	5%	
Per-hour			
2-hours	4/40	1%	0.00
3-hours	11/40	27.5%	
4-hours	26/40	65%	

DISCUSSION

Kidney failure requires continued dialysis sessions for long periods or even lifelong, which usually exposes the patient to blood-borne microbial infections such as hepatitis viruses, that in turn will significantly weaken the immunological efficiency level of patient and regarded as life threatening infections due to the major complications which could develop consequently (18). In the Middle East, the overall prevalence of viral infections in HD patients were considerable, it is estimated as the HBV rate was 4.4%, HCV was 25.3% and HIV was 0.1%-2 (19).

Present study appeared that the frequency of HCV and HBV were (9%,2.5%) respectively, which regarded more than results of many other similar studies that performed in Iraq such as, in Karbala in which HCV was (6.6%) and HBV was (0.6%) (20), in Duhok HCV was (4.3%) and HBV (2.1%) (21,22), in Baghdad HBV was (1.1%) (23), in Diwaniya HBV was (1.2 %) (24), in Kurdistan HBV was 1.8% (25). While, present result was lower than results of many other similar studies in Iraq such as: Nasiriya HBV was 3.7% (26), in Baghdad HCV was 26% (27), in Suleimani HCV was 26.7% (28), in Nasiriyah HCV was 30% (29), in Diwaniya 21.2 % (24), in Anbar HCV was 20% (30), in Muthanna HBV was 10% and HCV 36% (31), In Najaf HCV was 52.4% (32), in Basra HBV was 50% and HCV was 57.4% (33), in Anbar HCV was (11.7%) (34).

On the other hand, present result showed that rate of co-infection of both of HCV and HBV was 2.9%. This rate was more than similar study that conducted in Karbala which was 0% (20), in Diwaniya was 1.2 % (24) and lower than study that conducted in Mosul which was 25% (35,36). With regarded to HIV, present result showed there is no infection into study group. This rate agrees with other similar study in Dohuk (20), in Baghdad (37). Whereas, in other neighbor countries, the results of similar studies

were different, Saudi Arabia was 3.7% for HBV and 7.5% for HCV (38), in Jordan 5.9% for HBV, 36% for HCV and 2% for co-infection (39), in Turkey 2.4% for HBV, 5.5% for HCV and 1.02% for co-infections (40), in Syria HBV, HCV, co-infection and HIV were 3.2%, 22.1%, 0.7%, and 0%, successively (41), in Iran HBV was 2.1% and HCV was 8.27% (42). Accordingly, It should be noted that the most of HBV infected person will be susceptible to developing of chronic form, which is usually accompanied by the absence of related symptoms or biochemical or serological evidences, as the appearance of antibodies may be delayed to extend from 6-12 weeks after contracting the infection, Therefore, it is not possible to detect HBsAg against this virus during window period or occult HBV infections (OBIs) serologically, which in turn allows acquiring of viral infections to be transmitted easily (43,44).

In the same context, on the diagnostic level, the weakness of the immune system in those patients may not lead to stimulate of the production of antiviral immunoglobulins at a sufficient level, which conversely affects the accuracy of the serological diagnosis tests, so the result could appear falsely negative in the ELISA, while on the molecular diagnostic level, the polymerase chain reaction (PCR) could reveal positive test result. Consequently, misdiagnosis may allow the circulation of viral infections like (HBV, HCV and HIV) in the same patients group, due to share common transmission methods which regarded as risk factor, such as transmission via tools, devices, environment, medications, devices and equipment that could be contaminated with viral-load blood especially when a large number of patients are receiving HD treatment at the same time within the same contaminated dialysis unit, particularly in regions where there is a high prevalence of the mentioned viruses (45,46,47).

Besides, there are a nother risk factors that could makes the health level of HD patients is much worse, such as increased number of repeated dialysis sessions and duration which performed during a long time of dialysis procedures (48). Accordingly, the incidence rate of hepatitis virus infections in the elderly group is more than that of the young group as revealed in present study, which may be due to the above-mentioned reasons.

However, it is estimated that the infection with the HBV is less than HCV, which may be due to administration of HBV-vaccine and supposed isolation of the infected patients (45). This is consistent with the results of the current study. In this study, we noted a higher incidence of infection among males compared to females. This may be attributed to the behavioral nature and type of activities performed by male, which in turn may expose them to greater risk of infection. In addition, female generally develop more efficient level of immune response against viral infections than male in both of humoral and cellular levels as a result of sex-based biological differences between them in the disease development (49,50,51,52).

Rural areas typically are suffered from many healthcare issues due to several factors, including poverty, inappropriate population demographics, insufficient health awareness, inadequate health infrastructure such as hospitals and health workers, unsuitable sanitation, and insufficient health equipment supplying such as medicines, treatments, and diagnostic devices (53,54,55). Thus, all of these factors may explain the reason of the increase number of infections in rural areas compared to urban, as mentioned in the current study.

CONCLUSION

Based on this study, it was noted that there are worrying hepatitis infections among HD patients, especially in category HCV and to a lesser extent in category HBV, with a clear absence in the HIV category. Infection rates

according to present study, increased with the increasing in the number of dialysis sessions and duration of dialysis. Generally, It is necessary to apply the required health criteria to protect the patient's life from serious infections by adhering to the known health standards and controls.

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REFERENCES

- 1- Bello, A.K., Okpechi, I.G., Osman, M.A. *et al.* Epidemiology of haemodialysis outcomes. *Nat Rev Nephrol* 18, 378–395 (2022). <https://doi.org/10.1038/s41581-022-00542-7>
- 2- Liew, Adrian. “Perspectives in renal replacement therapy: Haemodialysis.” *Nephrology (Carlton, Vic.)* vol. 23 Suppl 4 (2018): 95-99. [doi:10.1111/nep.13449](https://doi.org/10.1111/nep.13449)
- 3- Vadakedath S, Kandi V. Dialysis: A Review of the Mechanisms Underlying Complications in the Management of Chronic Renal Failure. *Cureus*. 2017 Aug 23;9(8):e1603. [doi: 10.7759/cureus.1603](https://doi.org/10.7759/cureus.1603).
- 4- Iqbal MS, Iqbal Q, Iqbal S, Ashraf S. Hemodialysis as long term treatment: Patients satisfaction and its impact on quality of life. *Pak J Med Sci*. 2021 Mar-Apr;37(2):398-402. [doi: 10.12669/pjms.37.2.2747](https://doi.org/10.12669/pjms.37.2.2747).
- 5- Shafiee MA, Chamanian P, Shaker P, Shahideh Y, Broumand B. The Impact of Hemodialysis Frequency and Duration on Blood Pressure Management and Quality of Life in End-Stage Renal Disease Patients. *Healthcare (Basel)*. 2017 Sep 2;5(3):52. [doi: 10.3390/healthcare5030052](https://doi.org/10.3390/healthcare5030052).
- 6- Garthwaite E, Reddy V, Douthwaite S, Lines S, Tyerman K, Eccles J. Clinical practice guideline management of blood borne viruses

within the haemodialysis unit. *BMC Nephrol.* 2019 Oct 28;20(1):388. doi: 10.1186/s12882-019-1529-1.

7- 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 Jun 22;16(6):e0251570.

8-Bernieh B. Viral hepatitis in hemodialysis: An update. *J Transl Int Med.* 2015 Jun-Sep;3(3):93-105. doi: 10.1515/jtim-2015-0018.

9- Martyn E, Eisen S, Longley N, Harris P, Surey J, Norman J, Brown M, Sultan B, Maponga TG, Iwuji C, Flanagan S, Ghosh I, Story A, Matthews PC. The forgotten people: Hepatitis B virus (HBV) infection as a priority for the inclusion health agenda. *Elife.* 2023 Feb 9;12:e81070. doi: 10.7554/eLife.81070.

10- Abdel-Gawad, M., Nour, M., El-Raey, F. *et al.* Gender differences in prevalence of hepatitis C virus infection in Egypt: a systematic review and meta-analysis. *Sci Rep* 13, 2499 (2023).

11- Yang J, Qi JL, Wang XX, Li XH, Jin R, Liu BY, Liu HX, Rao HY. The burden of hepatitis C virus in the world, China, India, and the United States from 1990 to 2019. *Front Public Health.* 2023 Mar 2;11:1041201. doi: 10.3389/fpubh.2023.1041201

12- van Schalkwyk C, Mahy M, Johnson LF, Imai-Eaton JW. Updated Data and Methods for the 2023 UNAIDS HIV Estimates. *J Acquir Immune Defic Syndr.* 2024 Jan 1;95(1S):e1-e4. doi: 10.1097/QAI.0000000000003344

13- Kranthi Kosaraju, Sameer Singh Faujdar, Aashima Singh, Ravindra Prabhu, "Hepatitis Viruses in Hemodialysis Patients: An Added Insult to Injury?", *Hepatitis Research and Treatment*, vol. 2013, Article ID 860514, 4 pages, 2013. <https://doi.org/10.1155/2013/860514>

14- Patel PR, Thompson ND, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of hepatitis C virus infections in hemodialysis patients. *American Journal of Kidney Diseases.* 2010 Aug 1;56(2):371-8

15- Harfouche M, Chemaitelly H, Mahmud S, et al. Epidemiology of hepatitis C virus among hemodialysis patients in the Middle East and North Africa: systematic syntheses, meta-analyses, and meta-regressions. *Epidemiology and Infection.* 2017;145(15):3243-3263. doi:10.1017/S0950268817002242

16-Cavalcante MG, Parente MSR, Gomes PEAC, Meneses GC, Silva Júnior GBD, Pires Neto RDJ, Daher EF. Death-related factors in HIV/AIDS patients undergoing hemodialysis in an intensive care unit. *Rev Inst Med Trop Sao Paulo.* 2021 Apr 23;63:e33. doi: 10.1590/S1678-9946202163033.

17- Kranthi Kosaraju, Sameer Singh Faujdar, Aashima Singh, Ravindra Prabhu, "Hepatitis Viruses in Hemodialysis Patients: An Added Insult to Injury?", *Hepatitis Research and Treatment*, vol. 2013, 4 pages, 2013. <https://doi.org/10.1155/2013/860514>

18-Elahi W, Syed A, Nasim F, et al. (October 12, 2020) Hepatitis B and C Infections in Patients With Prolonged Hemodialysis Secondary to Chronic Renal Failure. *Cureus* 12(10): e10905. doi:10.7759/cureus.10905

19- Alkhalifah R H, Alhaddad M J, Alhashem A T, et al. (July 12, 2023) Prevalence of Hepatitis B Virus, Hepatitis C Virus, and HIV Infections in Hemodialysis Patients at Kano Kidney Center. *Cureus* 15(7): e41769. doi:10.7759/cureus.41769

20- Jasim NA, Athbi HA. Prevalence and Risk Factors for Hepatitis C and B Viruses Infection among Hemodialysis Patients in Holy Karbala, Iraq. *Kufa Jour. Nurs. Sci.* 2015 ; 5(3):142-9. Available from: <https://www.journal.uokufa.edu.iq/index.php/kjns/article/view/2793>

21- Ibrahim NM, Saleem ZS, Hussein NR. The Prevalence of HIV, HCV, and HBV among hemodialysis patients attending Duhok Hemodialysis Center. *International Journal of Infection.* 2018 Jan 31;5(1).

22- Saleem ZS, Naqid IA, Hussein NR, Mohammad SJ, Noaman JS, Haji RS, Haji VA,

- Hussein ZM, Mohammed PH. The prevalence of hepatitis B and C virus in patients with end-stage kidney disease on regular hemodialysis in Duhok, Iraq: A brief report. *Avicenna Journal of Clinical Microbiology and Infection*. 2020 ;7(1):31-3.
- 23- Fahmi N, Faruoq Z, Hassan WF, Ahmed A. Prevalence of viral hepatitis (B and C) in pediatric hemodialysis centers in Baghdad. *Iraqi Postgraduate Medical Journal*. 2018 Dec 28;17(4).
- 24- Al-Muramdy WH. Prevalence Rate of Hepatitis C virus (HCV) and Hepatitis B virus (HBV) Infection in Iraqi Patients on Hemodialysis: Cross-Sectional Study. *Medico-legal Update*. 2020 Jul;20(3):123-8.
- 25- Sinjari HY, Bakr KA. Prevalence and risk factors of hepatitis b and c virus infections among patients undergoing hemodialysis in kurdistan, Iraq. *Hepatitis Monthly*. 2018 May 31;18(5).
- 26- Musa MD, Ateya HK. Prevalence of overt and occult hepatitis B virus infections among 135 haemodialysis patients attending a haemodialysis centre at Al-Nasiriyah city, Iraq. *Iran J Microbiol*. 2020 Oct;12(5):475-482. doi: 10.18502/ijm.v12i5.4610. PMID: 33604004; PMCID: PMC7867696.
- 27- Amber AA, Eman AK, Al-Diwan JK. Hepatitis C Virus Infection among Patients in Hemodialysis Unit at Baghdad Teaching Hospital. *Iraqi Medical Journal*. 2021 Jul;67(2):51-6.
- 28- Ramzi ZS, Abdulla AA, AL-Hadithi T, Al-Tawil NG. Prevalence and Risk Factors for Hepatitis C Virus Infection in Hemodialysis Pateints in Sulaimani. *Zanco J Med Sci* [Internet]. 2018 Oct. 29 [cited 2023 Dec. 30];14(1 Special):44-50. Available from: <https://zjms.hmu.edu.krd/index.php/zjms/article/view/491>
- 29- Khalaf A, Hussein K. Assessment of Hepatitis C virus (HCV) associated with hemodialysis patients in Thi-Qar province, Iraq. In *Proceedings of 2nd International Multi-Disciplinary Conference Theme: Integrated Sciences and Technologies, IMDC-IST 2021*, 7-9 September 2021, Sakarya, Turkey 2022.
- 30- Abdulwahab HA, Al-Juboori R, Hamad R, Taqi M, Mahaan J, Abd MT. Seroprevalence of Hepatitis B & C Virus and Associated Risk Factors in Hemodialysis Units in Al-Anbar Province. *Journal of Global Scientific Research* (ISSN: 2523-9376). 2021;6(1):1051-68.
- 31- Hussein MM, AL Sabaagh SJ, Khalaf AM. Hepatitis B and C virus prevalence and risk factors among hemodialysis patients in Al-Muthanna city, Iraq. In *AIP Conference Proceedings 2024 Feb 16* (Vol. 3051, No. 1). AIP Publishing.
- 32- Al-Khafajy ZA, Al-hussein IQ, AL-Abedi HM, Al-Zeyadi AA. Prevalence of Hepatitis C among Patients Undergoing Hemodialysis in Dialysis Center in Al-Najaf Al-Ashraf Governorate. *EXECUTIVE EDITOR*. 2020 Feb;11(02):833.
- 33- Shihab SS, Al-Hmudi HA, Al-Edani HS, Mahdi KH. Viral hepatitis infections in Basrah hemodialysis unit: serological diagnosis and viral loading. *European Journal of Experimental Biology*. 2014;4(2):106-2.
- 34- Al-Mashhadani JI. Hepatitis C virus infection among haemodialysis patients in Al-Anbar governorate. *Iraqi Journal of Community Medicine*. 2007;20(1):20-3.
- 35- Shafiq MY. Prevalence of Hepatitis B virus in hemodialysis patients infected with Hepatitis C virus in Mosul district/Iraq. *Iraqi J Gastroenterol*. 2012;1(3):52-60.
- 36- Al-Ta'an GS, Khalid MD. Prevalence of hepatitis B virus in hemodialysis patients infected with hepatitis C virus in Mosul District/Iraq. *American Academic Scientific Research Journal for Engineering, Technology, and Sciences*. 2020 Jan 8;63(1):1-6.
- 37- Kamal IMA, Mahdi BM. Seroprevalence occurrence of viral hepatitis and HIV among hemodialysis patients. *Ann Med Surg (Lond)*. 2018 Mar 16;29:1-4. doi: 10.1016/j.amsu.2018.03.018.

- 38-Alkhalifah R H, Alhaddad M J, Alhashem A T, et al. (July 12, 2023) Prevalence of Hepatitis B Virus, Hepatitis C Virus, and HIV Infections in Hemodialysis Patients at Kano Kidney Center. *Cureus* 15(7): e41769. [doi:10.7759/cureus.41769](https://doi.org/10.7759/cureus.41769)
- 39-Hijazat, Munther Al,1,; Ajlouni, Yousef M.,2. Hepatitis B Infection among Patients Receiving Chronic Hemodialysis at the Royal Medical Services in Jordan. *Saudi Journal of Kidney Diseases and Transplantation* 19(2):p 260-267, Mar–Apr 2008
- 40-Kizilates F, Berk H, Coban M, Seyman D, Sarikaya M, Sari F, Oztoprak N. Seroprevalence of hepatitis B and C virus in patients who undergo hemodialysis in Antalya province, Turkey. *Asian Biomedicine*. 2016 Aug 1;10(4):339-44.
- 41-Altinawe, J., Akkawi, M.E., Kharrat Helu, N. *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* 24, 289 (2024). <https://doi.org/10.1186/s12879-024-09177-4>
- 42-Roushan MR, Farokhtabar S, Bayani M, Siadati S. Epidemiological aspects of hepatitis B and C and human immunodeficiency viruses among hemodialysis patients in Mazandaran Province, Iran. *Nephro-urology monthly*. 2016 May;8(3).
- 43- Prakash, S., Jain, A., Sankhwar, S. N., Usman, K., Prasad, N., Saha, D., ... & Singh, D. D. (2014). Prevalence of hepatitis B & C viruses among patients on hemodialysis in Lucknow, Uttar Pradesh. *Clinical Epidemiology and Global Health*, 2(1), 19-23.
- 44- Karimi, G., Zadsar, M., Vafaei, N. *et al.* Prevalence of antibody to Hepatitis B core antigen and Hepatitis B virus DNA in HBsAg negative healthy blood donors. *Virol J* 13, 36 (2016). <https://doi.org/10.1186/s12985-016-0492-8>
- 45-Malhotra R, Soin D, Grover P, Galhotra S, Khutan H, Kaur N. Hepatitis B virus and hepatitis C virus co-infection in hemodialysis patients: A retrospective study from a tertiary care hospital of North India. *J Nat Sci Biol Med*. 2016 Jan-Jun;7(1):72-4. [doi: 10.4103/0976-9668.175076](https://doi.org/10.4103/0976-9668.175076).
- 46- Malhotra, Rubina et al. “Hepatitis B virus and hepatitis C virus co-infection in hemodialysis patients: A retrospective study from a tertiary care hospital of North India.” *Journal of natural science, biology, and medicine* vol. 7,1 (2016): 72-4. [doi:10.4103/0976-9668.175076](https://doi.org/10.4103/0976-9668.175076)
- 47- Al-Hegami MA, Al-Mamari A, Al-Kadasse AS, Al-Gasha’a FA, Al-Hag S, Al-Hegami AA. Prevalence and risk factors of hepatitis B and hepatitis C virus infections among patients with chronic renal failure in Zabeed city, Yemen Republic. *Open Journal of Medical Microbiology*. 2015 Aug 13;5(3):136-42
- 48- Ogunleye A, Oluwafemi TT, Akinbodewa AA, Daomi VO, Adejumo OA, Omisakin TC. Seroprevalence of Hepatitis B, C and coinfection among patients with chronic kidney disease in a Nigerian hospital. *Saudi Journal of Kidney Diseases and Transplantation*. 2020 May 1;31(3):647-54
- 49- Jacobsen H, Klein SL. Sex Differences in Immunity to Viral Infections. *Front Immunol*. 2021 Aug 31;12:720952. [doi: 10.3389/fimmu.2021.720952](https://doi.org/10.3389/fimmu.2021.720952).
- 50- Bashir Hamidu R, Chalikonda DM, Hann H-W. Gender Disparity in Host Responses to Hepatitis B-Related Hepatocellular Carcinoma: A Case Series. *Vaccines*. 2021; 9(8):838. <https://doi.org/10.3390/vaccines9080838>
- 51-Ruggieri A, Anticoli S, D’Ambrosio A, Giordani L, Viora M. The influence of sex and gender on immunity, infection and vaccination. *Annali dell'Istituto superiore di sanita*. 2016 Jun 28;52(2):198-204.
- 52- Dias SP, Brouwer MC, van de Beek D. Sex and Gender Differences in Bacterial Infections. *Infect Immun*. 2022 Oct 20;90(10):e0028322. [doi: 10.1128/iai.00283-22](https://doi.org/10.1128/iai.00283-22).

53-Couper I, Lediga M , Takalani NB, Floss M, Yeoh AE, Ferrara A, Wheatley A, Feasby L, De Oliveira Santana MA, Wanjala MN, Tukur MA, Kotian SP, Rasic V, Shirindza V, Chater AB, Koller TS. Shaping the future rural healthcare landscape: perspectives of young healthcare professionals. Rural and Remote Health 2024; 24: 8792.

<https://doi.org/10.22605/RRH8792>

54-

<https://www.sciencedirect.com/science/article/pii/S2949866X23000576>.

55- Cuadros DF, Branscum AJ, Mukandavire Z, Miller FD, MacKinnon N. Dynamics of the COVID-19 epidemic in urban and rural areas in the United States. Annals of epidemiology. 2021 Jul 1;59:16-20.