

# Seroprevalence of co-infection with HIV and viral hepatitis B and C viruses at the Al Nadjma multi-purpose Center Laboratory in N'Djamena (Chad)

## ABSTRACT

Co-infection with hepatitis B and C is one of the major challenges in the management of HIV since access to antiretroviral drugs has improved in Africa. The aim of this study was to determine the seroprevalence HIV/Hep B and C co-infection in patients treated at the Al Nadjma multi-purpose centre in N'Djamena, Chad. This prospective study was conducted from June 2023 to May 2024 on 3,430 patients seen at the laboratory of the Al Nadjma multi-purpose Center in N'Djamena for screening for both HIV and hepatitis B and C. HIV was detected by immuno-chromatography using specific kits. The detection of hepatitis B and C by detection of HBsAg and HCV AC was carried out by immunochromatography using specific kits. The results showed that the prevalence of HIV/HBV co-infection was 2.3%. The mean age of the patients was 38 years, with extremes of 18 and 60 years. Males were predominant (71.2%), with a sex ratio (M/F) of 1.22. The most common age was 31 to 40 (38.48%). The prevalence of HIV, hepatitis B and hepatitis C was 4.84%, 4.46% and 0.93% respectively. The prevalence of HIV/HBV, HIV/HCV and HIV/HBV/HCV co-infections was 4.17%, 0.79% and 0.09% respectively. This study shows that HIV and hepatitis B seroprevalence are high in N'Djamena. On the other hand, hepatitis C virus and HIV/HCV and HIV/HBV/HCV co-infections are relatively low compared with most of the data reported in other Sub-Saharan African countries. However, HIV/HBV co-infection could be considered a public health problem, requiring early diagnosis by organizing awareness and screening campaigns in the population, thus enabling better management of co-infected patients (HIV/HBV) by dual antiretroviral and anti-hepatitis B treatment.

**Comment [h1]:** You have given two prevalences of HIV-HBV co-infection (2.3% and 4.17%) in the abstract

*Keywords: Seroprevalence, Co-infection, HIV, HBsAg (HBV), HCV, N'Djamena, Chad.*

## 1. INTRODUCTION

The pandemic of infection by the Human Immunodeficiency Virus (HIV) is far from being under control, despite the major interventions carried out worldwide [1]. Access to antiretroviral treatment in sub-Saharan Africa remains very poor, due to obstacles such as the limited number of doctors, limited viral load testing, and problems with the availability of simpler tests such as CD4 T-cell or biochemistry tests [2-5]. Despite this, HIV, with its virulence, is not the only health threat. There are also other viruses whose expansion and evolution are worrying, notably the hepatitis B virus (HBV) and the hepatitis C virus (HCV), which are also major public health problems. A silent killer, viral hepatitis is a global public health problem, causing more than 1.4 million deaths each year worldwide [6]. Hepatitis B and C are the two main forms of viral hepatitis, causing liver damage and sometimes fatal cancer.

It is estimated that around two billion people worldwide are infected with the hepatitis B virus, of whom more than 350 million have chronic liver disease. Between 500,000 and 700,000 people die from hepatitis B every year [7]. These deaths are mainly due to complications of chronic hepatitis, namely cirrhosis and primary liver cancer [8]. Some 130 to 170 million people are chronic carriers of hepatitis C, and it is estimated that more than 350,000 people die each year from hepatitis C-related liver [7]. What's more, from a therapeutic point of view, both hepatotropic viruses require extensive treatment, which is often poorly tolerated and often leads to complications making prevention the only effective means of combating the disease [7,9]. Co-infection with the human immunodeficiency virus (HIV) and the hepatitis B and C viruses is common and constitutes a major public health problem worldwide. HIV infection alters the natural history of HBV and worsens the prognosis chronic hepatitis B [10-13]. HIV infection increases the HCV viral load by a factor of 2 to 8, leading on the one hand to an increased risk of maternal-foetal transmission (from 3 to 20%) and sexual transmission (from 0 to 3%) of HCV compared with HCV mono-infection, and on the other hand to a reduction in spontaneous recovery from acute hepatitis C [14].

The viruses responsible for these diseases share the same modes of transmission: sexual, blood transfusion, injection drug use [15-18]. HIV infection worsens the prognosis of liver disease associated with hepatitis C virus and hepatitis B virus [19].

Sub-Saharan Africa remains the part of the world most affected by this pandemic, with the HIV infection rate study indicating that the virus is still the most frequent cause of death in sub-Saharan Africa, despite the rapid development of antiretroviral therapy [20]. The 2013 UNAIDS report estimates that 4 to 5 million people living with HIV/AIDS are co-infected with the hepatitis C virus and more than 3 million with the hepatitis B virus.

In Chad, the figures, while still fragmentary and limited, are still alarming. According to recent data from the World Health Organisation, the country is one of the high-prevalence areas for hepatitis, with a prevalence of hepatitis B of around 19% in the population. Among women attending antenatal clinics, it is around 4.6%, seroprevalence of the hepatitis C virus is around 2.5% [6].

The main gap that needs to be filled is the low coverage of screening and treatment to achieve the global goals of eliminating hepatitis by 2030 [6].

The objective of this study is to determine the seroprevalence of HIV/Hepatitis B and C co-infection in patients admitted to the Al Nadjma multi-purpose Center in N'Djamena, Chad.

## 2. MATERIAL AND METHODS

This is a prospective study lasting 12 months, from June 2023 to May 2024, carried out in the laboratory of the Al Nadjma multi-purpose Center, which is a national reference Center for the care of people living with HIV/AIDS and viral hepatitis. The study population of male and female patients over 18 years of age who were seen at the laboratory of the Al Nadjma multi-purpose Center in N'Djamena for screening for both HIV and hepatitis B and C. Patients agreed to participate in this study without coercion. We used exhaustive empirical sampling. Our data were collected using a pre-established survey questionnaire.

This questionnaire was used to collect the socio-demographic data of the patients surveyed (age, sex, profession, level of education, place of residence, family situation), as well as biological data (results of screening for HIV, hepatitis B and hepatitis C). Venous blood taken from all in a collection tube containing anticoagulants, to test plasma or serum for HIV, HBV and HCV.

**Comment [h2]:** It is important for an article that is limited to screening to detail the screening procedure from the amount of blood collected to the technique

Testing for hepatitis B and C by detection of HBsAg and HCV AC was carried out by immunochromatography specific kits (Cypress HBsAg Dipstick and Human

Hexagon HBsAg and ACHCV). HIV testing was performed by immunochromatography using *HIV Determine* kits, followed by confirmation typing (HIV-1/2 3.0 Bioline, Standard Diagnostics, INC, Republic of Korea). Confirmation was performed by ELISA using the mini-Vidas automated system, in accordance with the manufacturer's recommendations (bio-Mérieux, Marnes La Coquette, France).

The data were analyzed using Excel 2017 software. Anonymity was ensured by using the patient's registration. This study was conducted in compliance with ethical rules and the Helsinki agreement. Patient consent was required.

### 3. RESULTS AND DISCUSSION

#### 3.1 Sociodemographic characteristics

In total, the sample consisted of 3430 patients received at the laboratory of the Al Nadjma multi-purpose centre in N'Djamena for screening for HIV, hepatitis B and hepatitis C. The sample was predominantly male, with 55.01% of participants, giving a sex ratio (M/F) of 1.22 men to 1 woman (Figure 1).

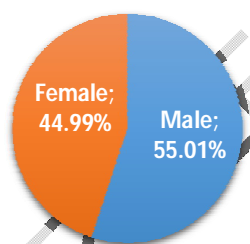
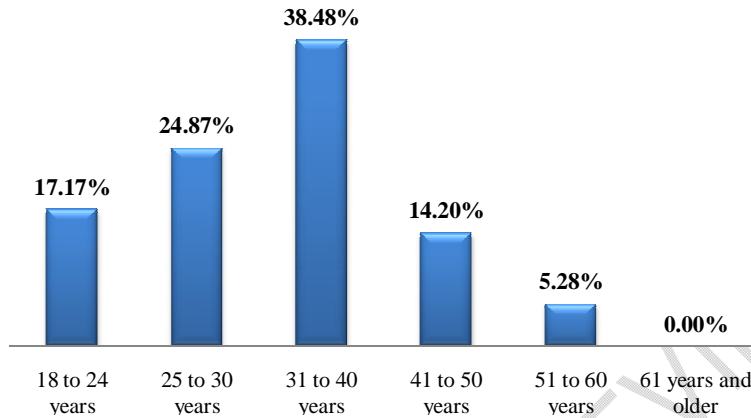


Fig. 1. Distribution of co-infections by sex

The mean age of the participants was 38 years with extremes of 18 and 60 years. The most represented age group was that of patients aged 31 to 40 years with 38.48% of patients, followed by those of 25 to 30 years and 18 to 24 years with 24.87% and 17.17% of patients respectively (Figure 2). It should be noted that in our study there is no co-infection in the age group of 61 years and older.



**Fig. 2. Distribution of co-infections by level of education**

According to the level of education, patients with higher education constituted the dominant class with 28.63% followed by those with secondary and primary education with 26.71% and 23.73% respectively each (Table 1). Those with no level of education represented 20.93% of the patients.

**Table 1. Distribution of co-infections by level of education**

Variable	Number of Patients (3430)	Percentage (%)
None	718	20.93%
Primary	814	23.73%
Secondary	916	26.71%
Superior	982	28.63%

The results according to the marital status of the participants showed that 50.87% of our patients are married, 28.28% and 12.42% of the patients are single and divorced respectively while only 8.28% of them are widowed.

**Table 2: Distribution of co-infection according to marital status**

Variable	Number of Patients (3430)	Percentage (%)
Single	970	28.28%
Married	1745	50.87%
Divorced	426	12.42%
Widowed	289	8.43%

### 3.2 Prevalence of HIV, HBV, HCV and HIV/HBV/HCV co-infection

Overall prevalence of HIV infection was 4.84% for all patients screened in this study. The prevalences of hepatitis B and C were 4.26% and 0.93% respectively, while those of

HIV/HBV, HIV/HCV and HIV/HBV/HCV co-infections were 4.17%, 0.79% and 0.09% respectively (Table 3).

**Table 3: Prevalence of HIV, HBV, HCV and Co-infections**

Variables	Number of Patients (3430)	Percentages (%)
<b>HIV</b>		
Positive	166	4.84%
Negative	3264	95.16%
<b>AgHBs</b>		
Positive	146	4.26%
Negative	3284	95.74%
<b>AcHcv</b>		
Positive	32	0.93%
Negative	3398	99.07%
<b>HIV/AgHBs</b>		
Positive	143	4.17%
Negative	3287	95.83%
<b>HIV/AcHcv</b>		
Positive	27	0.79%
Negative	3403	99.21%
<b>HIV/AgHBs/AcHcv</b>		
Positive	3	0.09%
Negative	3427	99.91%

**Comment [h3]:** It is important to reformulate the prevalence of viral hepatitis C and co-infections with this virus since you will have to proceed with serology, without RNA.

**Comment [h4]:** Make the table conventionally

**Comment [h5]:** Make the table conventionally

### 3.3 Discussion

Our results showed that male subjects included in the study were the most numerous (55.01%), with a sex ratio (M/F) equal to 1.22. The same dominance of men was found in a study conducted at the Sino-Guinean Friendship Hospital in Conakry (Guinea) where the authors found 71.2% of men, with a sex ratio (M/F) equal to 2.47. These results are diametrically opposed to those reported in Botswana and Ghana where the authors worked respectively on a population of 118 patients with 67.8% female (sex ratio M/F = 0.67) and 320 participants including 72.5% female (sex ratio M/F = (0.37) [21,22].

The mean age of our patients, which was 38 years, is close to the value of 37 years found in Guinea [21], of 35 years found in Botswana [22] and 40 years reported in Ghana [23]. The most represented age group was 31 to 40 years with 38.48% of respondents. This value is comparable to that of Makenara and al, in 2019 where the cumulative total of the two age groups of 25 to 29 years and 30 to 34 years is equivalent to 38.5% [21] and to that of 37.2% reported in 2016 in Ghana by Kye-Duodu and al, whose most represented age group was 31-40 years old [23].

**Comment [h6]:** You must improve your discussion, which must strive to give the reason for your results and to give the data explained by the same reasons. Discussion is not just about giving your results and those that are superior, inferior or the same as yours

**Comment [h7]:** Why is there a male predominance?

But this value remains lower than the results reported in Botswana which were 46.39% for the 30-39 age group [22]. The representativeness of the 31 to 40 age groups could be explained by the intense sexual activity and youth of this population. Married patients represented the majority of patients surveyed (50.87%). This category of marital status seems to be much more exposed.

The overall seroprevalence of HIV infection was 4.84% for all patients screened. This result is low compared to that reported by many studies conducted on HIV in sub-Saharan Africa such as those observed in 2019, 2016 and 2015 in Guinea, Nigeria and Cameroon respectively [21, 24, 25]. In Zambia, the authors reported an HIV infection rate of 9.9% [26] and in Cameroon, the prevalence of HIV infection was 6.0% [1]. Sexually transmitted infections (STIs) play a role in the sexual transmission of HIV [27,28].

The prevalence of hepatitis B virus (HBV) in our study was 4.26%. It was comparable to that reported in the city of Bafoussam by [1]. The prevalence of hepatitis B virus in this city was 4.1%.

The rate of 4.26% is significantly lower than that found in Guinea (17.9%) [21] and Nigeria (47.5%) [24]. It is also lower than that of the sub-Saharan region of Africa where the hepatitis B virus carriage rate varies from 5 to 20% [29,30]. The seroprevalence of 4.26% for hepatitis B in the present study is a moderate seroprevalence according to the WHO classification criteria. The WHO considers HBV seroprevalence to be low if it is less than 2%, moderate if it is between 2% and 8%, and high if it is than 8% [28, 31].

The prevalence of HIV and hepatitis B co-infection in the present study was 4.17%. This prevalence is higher than 2.3% reported in Guinea by [21]. On the other hand, this prevalence is lower than 5.1% reported in Botswana [22] and 16.9% in Benin at the Parakou University Hospital [32]. Similarly, the prevalence observed in this study is lower than those reported in Kenya which is 6% and 5.7% [29, 33]. This prevalence is also lower than 8.8% reported in Tanzania and 20.4% observed in Malawi [34]. As for the hepatitis C virus (HCV), its prevalence was 0.93%, slightly higher than the study by Francois-Xavier Mbopi-Keou and al., who reported a prevalence of 0.4% [1].

#### **4. CONCLUSION**

HIV, hepatitis B and HIV/HBV co-infection were more frequently observed. The observed seroprevalences of HIV, hepatitis B and HIV /HBV co-infection suggests that these viral diseases are a significant public health problem in Chad. These seroprevalences call on health authorities to organize, on the one hand, awareness campaigns for the population to change behavior by applying measures to prevent sexually transmitted infections, and on the other hand, HBV and HIV screening campaigns in the population, as well as screening for the hepatitis B virus in all HIV-positive patients. Finally, treat HIV/HBV co -infected patients with antiretroviral and anti-hepatitis B molecules.

#### **Disclaimer (Artificial Intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## REFERENCES

1. Francois-Xavier MK, Isabelle VMN, Ginette CMK, Georges NT, Hortense GK, Michel N, Côme EM, Maurice AS, 2015. Seroprevalence and factors associated with HIV and viral hepatitis B and C in the city of Bafoussam in Cameroon. *Pan African Medical Journal*, 20:156 <http://doi:10.11604/pamj.2015.20.156.4571>
2. UNAIDS, 2010. Report on the global AIDS epidemic 2010. (Joint United Nations Programme on HIV/AIDS).
3. Gruenais ME, 2001. A changing health system: the case of Cameroon. *Euro-African Association for the Anthropology of Social Change and Development. APAD Bulletin No. 21, Paris, 2001.*
4. McCoy D, Chopra M, Loewenson R, Aitken JM, Ngulube T, et al. 2005. Expanding access to antiretroviral therapy in sub-saharan Africa: avoiding the pitfalls and dangers, capitalizing on the opportunities. *Am J Public Health*. 2005; 95(1):18-22. PubMed |
5. Schneider H, Blaauw D, Gilson L, Chabikuli N, Goudje J. Health systems and access to antiretroviral drugs for HIV in Southern Africa: service delivery and human resource challenges. *Reprod Health Matters*. 2006; 14 (27): 12-23. PubMed |
6. WHO, 2022. World Health Organization, 2022. World Hepatitis Day.
7. WHO, 2010. Report of the seventy-third World Health Assembly on viral hepatitis. WHO; 2010.
8. Berthe K, 2010. Seroprevalence of HBV/HIV coinfection among clients consulting at the CDV of the PASTEUR Institute of Ivory Coast. Doctoral thesis Bamako 2010.
9. Acar Ali, Kemahli Sabri , Altunay Husnu , Kosan Erdogan , Oncul Oral, Gorenek Levent et al. 2010. HBV, HCV and HIV seroprevalence among blood donors in Istanbul, Turkey: how effective are the changes in the national blood transfusion policies? *Braz J Infect Dis*. 14(1): 41-46. PubMed |
10. Soriano V, Barreiro P, Nunez M, 2006. Management of chronic hepatitis B and C in HIV- coinfectd patients. *J Antimicrob Chemother*, 57: 815-818.
11. Nunez M, Soriano V, 2005. Management of co-infected patients with hepatitis B virus and HIV. *Lancet Infect Dis*, 5: 374-382.
12. Konopnicki D, Mocroft A, De Wit S et al. 2005. Hepatitis B and HIV: prevalence, AIDS progression, response to highly active antiretroviral therapy and increased mortality in EuroSIDA cohort. *AIDS*, 19: 593-601.
13. Dieterich DT, 2007. Special considerations and treatment of patients with HBV-HIV coinfection. *Antivir Ther*, 12 ( Suppl. 3 ): H43-H51.
14. Vallet-Pichard A, Pol S, 2006. Natural history and predictors of severity of chronic hepatitis C virus (HCV) and humans immunodeficiency virus (HIV) co-infection . *J Hepatol*, 2006, 44 (Suppl.): S28-S34.
15. Ramezani A, Amirmoezi R, Volk JE, Aghakhani A, Zarinfar N, McFarland W, Banifaz M, Mostafavi E, Ali Eslamifar A, and Sofian M. 2014. HCV, HBV, and HIV seroprevalence , co-infections , and related behaviors among male injection drug users in Arak, Iran. *AIDSCare* . 26(9): 1122–1126.
16. Phung BC, Sogni P., Launay O. 2014. Hepatitis B and human immunodeficiency virus co-infection . *World J Gastroenterol* . 14; 20 (46): 17360-17367.
17. Ojide CK, Kalu EI, Ogbaini -Emevon E, VU Nwadike VU, 2015. Co -infections of hepatitis B and C with human immunodeficiency virus among adult patients attending human immunodeficiency virus outpatients clinic in Benin City, Nigeria. *Nigerian Journal of Clinical Practice*. Vol 18. Issue 4.
18. Isa I, Aminu M, Abdullahi SA, Sani MA, Usman MA, Esona MD, Ella EE. 2017. Seroprevalence of Hepatitis B Virus and Human Immunodeficiency Virus Infection

- among Students in Ahmadu Bello University, Zaria, Nigeria. Arch Med Biomed Res . 3:77-90
19. Pilly ECN, 2018. Infectious and tropical diseases. 5th Edition. ALINéA Plus, Paris, 324 p.
  20. WHO, 2019. Progress report on HIV, viral hepatitis and sexually transmitted infections 2019. Accountability for the global health sector strategies, 2016–2021]. Geneva: World Health Organization; 2019 (WHO/CDS/HIV/19.7). Geneva, Switzerland, <https://iris.who.int/bitstream/handle/10665/329875/WHO-CDS-HIV-19.7-eng.pdf>
  21. Makanera A, Dramou I, Sidibe S, Conde M, Sy O, Camara L B, Diallo MA, Barry AO, Camara D, Diakite T, Conde M, Samake A T, 2019. Seroprevalence of HIV/hepatitis B virus co-infection at the Sino-Guinean Friendship Hospital (HASIGUI) Kipé /Conakry (Guinea). Journal of Applied Biosciences 135: 13789 – 13807. <https://dx.doi.org/10.4314/jab.v135i1.6>
  22. Mandiwana A., Tshitenge S. 2017. Prevalence of human immunodeficiency virus-hepatitis B virus co-infection amongst adult patients in Mahalapye, Ngami , Serowe, Botswana: a descriptive cross- sectional study . South African Family Practice. 59(3):94–97.
  23. Kye-Duodu G., Nortey P., Malm K., Nyarko KM, Sackey SO, Ofori S., Afari EA 2016. Prevalence of hepatitis B virus co-infection among HIV- seropositive people attending antiretroviral clinics in the Eastern Region of Ghana. The Pan African Medical Journal. 25(Supp1):7. <http://doi:10.11604/pamj.supp.2016.25.1.6172>.
  24. Opaleye O, Akanbi O, Binuyo M, 2017. Prevalence of HBV, HIV, and HIV-HBV Co-infections among healthcare workers in Ibadan, Nigeria. BMJ Glob Health . 2( Suppl 2): A1-A67.
  25. Mbopi-Keou FX, Nkala IVM, Kalla GCM, NguéackTsague G, Kamga HG, Noubom M, Mvogo CE, Sosso MA. 2015. Seroprevalence and factors associated with HIV and viral hepatitis B and C in the city of Bafoussam in Cameroon. Pan African Medical Journal. 20:156.
  26. Kapembwa KC, Goldman JD, Lakhi S, Banda Y, Bowa K, Vermund SH, Mulenga J, Chama D., Chi BH. 2011. HIV, Hepatitis B, and Hepatitis C in Zambia. J Glob Infect Dis . 3:269-274.
  27. Mbopi Keou FX, Gresenguet G, Mayaud P, Weiss HA, Gopal R, Matta M, Brown D, et al. 2000. Interactions between Herpes simplex virus type 2 and HIV infection in women in Africa: opportunities for intervention. J infect Dis. 2000; 182 (4):1090-1096. PubMed
  28. Mbopi-Keou FX, Belec L, Teo CG, Scully C, Porter S. 2002. Synergism between human immunodeficiency viruses and others viruses in the mouth. Lancet Infect Dis. 2002; 2 (7): 416-424. PubMed
  29. Muriuki BM, Gicheru MM, Wachira D, Nyamache AK, and Khamadi SA. 2013. Prevalence of hepatitis B and C viral co-infections among HIV-1 infected individuals in Nairobi, Kenya. BMC Research Notes. 6: 363. <http://www.biomedcentral.com/1756-0500/6/363>.
  30. WHO. 2015. 2016-2021 Global Health Sector Strategies for HIV, Viral Hepatitis and Sexually Transmitted Infections. [www.who.int/hiv/strategy\\_2016-2021](http://www.who.int/hiv/strategy_2016-2021)
  31. WHO, 2016. Prevalence of hepatitis B virus infection in the world by country. Available at : <http://www.who.int/csr/disease/hepatitis/en/>
  32. Dovonou CA, Amidou SA, Kpangon AA, Traoré YA, Godjedo TPM, Satondji AJ, Wachinou AP, Issa-Djibril FM, Fourn L, Zannou DM, Gandaho P. 2015. Prevalence of hepatitis B in HIV-infected people in Parakou, Benin. Pan African Medical Journal. 20:125 <http://doi:10.11604/pamj.2015.20.125.6061>.
  33. Wambani RJ, Ogola PE, Makori AW, Nyamai DW, Lihana R, Burugu MW. 2015. Hepatitis B and C Co-Infections among HIV-1 Infected Patients Attending the



- Academic Model Providing Access to Healthcare Clinic , Kenya, 2014. J Infect Dis Diagn . 1:102. <http://doi:10.4172/jidd.1000102>
34. Nyirenda M, Beadsworth MB, Stephany P, Hart CA, Hart IJ, Munthali C, Beeching NJ, Zijlstra EE. 2008. Prevalence of infection with hepatitis B and C viruses and coinfection with HIV in medical inpatients in Malawi. J Infect. 57(1):72-77.

UNDER PEER REVIEW