**Seroprevalence of Hepatitis B Virus and Human Immunodeficiency Virus in the Population of Kara, Togo**

Abstract :

The town of Kara, Togo's second largest city, lies 400 km from the capital and is home to a diverse, predominantly rural population. The aim was to estimate the prevalence of HBsAg and human immunodeficiency virus (HIV) in 6 villages in the town, and to identify associated factors. We carried out immunochromatographic screening for HBsAg (ONE STEP RAPID TEST, HIGHTROP Biotech, Co LTD) and HIV antibodies (DETERMINE HIV-1/2 ® Kit, ABOTT, Co LTD) during mobile clinics initiated by the Faculty of Health Sciences in April 2024. A total of 1157 patients, of whom 69% (N=1100) [IC95%: 67 to 71] were women, were consulted. HBsAg was detected in 8.76% (N=140), with 67% women and 33% men. Of the positive cases, 3.6% were in the 0-15 age group (N=5). For 1396 patients screened, the prevalence of anti-HIV-1 antibodies was 3.51%, 82% (N=40) of whom were women and 18% (N=9) men. Age was the associated factor. HIV seroprevalence was higher in subjects aged between [31-45] and [46-60] years than in other age groups (p<0.001). Co-infection with both viruses was found in 5 patients. We therefore need to step up public awareness and education to prevent new infections.

**Key words:** co-infection; HBsAg; HIV; immunochromatographic screening; prevalence, antibodies

INTRODUCTION

Viral hepatitis B and HIV infection are major public health issues. Hepatitis B virus (HBV) infection of the liver presents several clinical aspects, with the risk of chronicity and hepatocarcinoma. According to WHO estimates, by 2022, 254 million people will be chronically infected and living with hepatitis B virus, 65% of them in Africa and the Asia-Pacific region[1]. Infection with the Human Immunodeficiency Virus (HIV) is a lifelong infection which, left untreated, leads to a weakening of the immune system, resulting in the deterioration of the infected person's health and eventual death. According to the WHO, 25.6 million people are living with HIV, and by 2022, 380,000 people will have died of AIDS and 760,000 will have been newly infected [2].

These two viruses share, for the most part, the same routes of contamination: sexual, parenteral, vertical (maternal-fetal), and are responsible for high morbidity and mortality, especially in Africa. In the absence of adequate treatment and diagnosis, the risk of mother-to-child transmission of HIV is 15-45%, and 90% of children infected with HBV at birth before the age of 5 have a 90% chance of becoming chronically ill [3,4].

In Africa, the prevalences of viral hepatitis B and HIV are 4.9% and 6.1%[2,5]. Despite these high prevalences, many people are unaware of their serological status with regard to these two viruses. One of WHO's strategies for eliminating viral hepatitis B and C by 2030 is to reduce the number of new cases of chronic infection due to these viruses. In the case of HIV, the aim is to detect 90% of infected people and put them on treatment. Diagnosis of these infections remains the main means of achieving these objectives. In fact, knowing one's serological status enables appropriate care to be taken, thereby reducing the number of new infections.

Togo is one of the countries in sub-Saharan Africa where hepatitis B is endemic and HIV infection rates are around 6.1% and 4.9% respectively; Africa accounts for 68% of hepatitis B and HIV infections worldwide [6]; and has the highest rate of liver cancer resulting from HBV infection[7]. The lack of financial resources among the population is a barrier to the use of healthcare centers. Data on the prevalence of these two viruses are mostly available for the capital Lomé [8-10]. With this in mind, we set out to gain an overview of the regional prevalence of HIV and HBV in the Togolese population by carrying out the present study, the main objective of which was to determine the prevalence of HIV and HBV in six cantons of the town of Kara.

**PATIENTS AND METHOD**

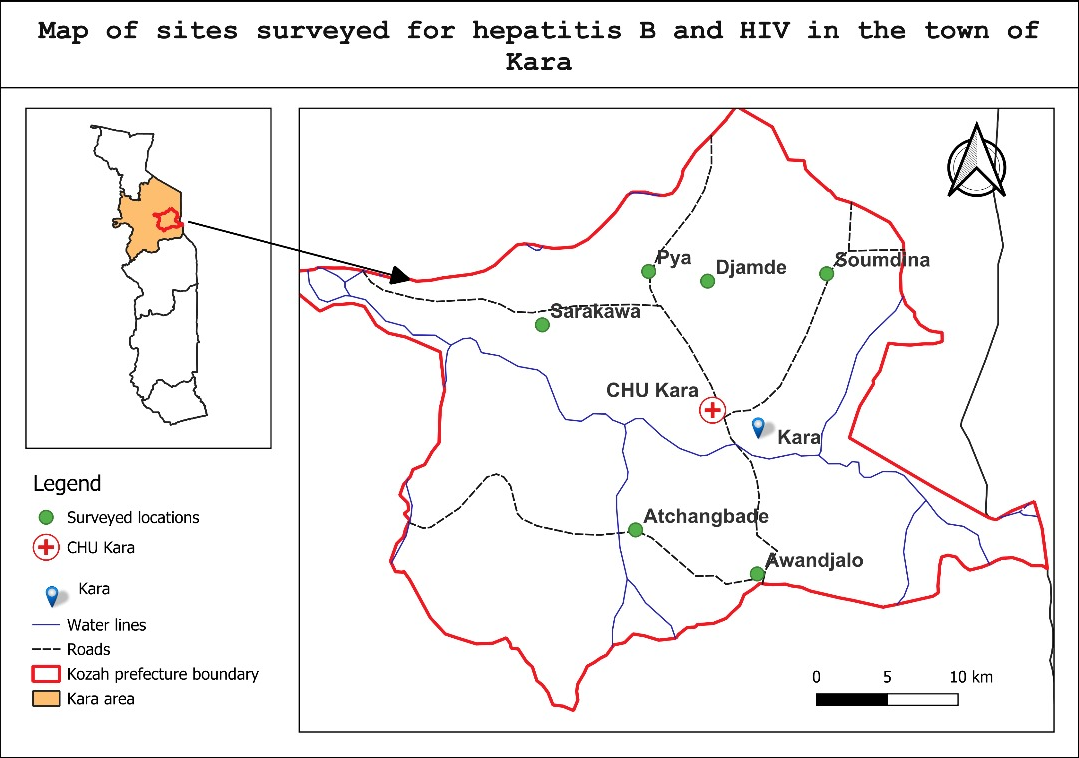
This was a descriptive, analytical, cross-sectional study. The study was carried out in the town of Kara, located 423 km north of Lomé, the capital of Togo. The town of Kara comprises 283738 inhabitants divided into 15 cantons. For this study, we targeted 6 cantons in each of the city's 4 communes: Awandjelo (commune 3), Atchamgbadè, Djamdè (commune 4), Soumdina-bas (commune 1), Sarakawa and Pya (commune 2), based on geographical accessibility to health care centers. This study was carried out as part of the mobile consultations undertaken by the Faculty of Health Sciences (FSS) of the University of Kara (UK) during the organization of its 3rd Scientific Days from April 12 to 16, 2024.

Screenings were carried out at each site in one day. Prior announcement was made via the media, with the various medical-social centers in each village relaying the information. In addition, the local administrative authorities (mayors and the prefect of the town of Kara) gave their authorization for the consultations to take place. For screening, authorization was obtained from the Regional Director of Health.

At each site, the population was made aware of viral hepatitis B and HIV-AIDS. Screening was spontaneous and voluntary after receiving their consent, with results recorded in the patient's health record. In the event of a positive result, counseling was initiated and follow-up scheduled with the health center referral. Patients were not asked to pay for their screening.

Screening for these two viruses was carried out on capillary blood using an immuno-chromatographic test such as ONESTEP RAPID TEST, HIGHTROP Biotech, Co LTD for the detection of HBs antigen (HBsAg), and the DETERMINE HIV-1/2 ® Kit, ABOTT, Co LTD for the detection of HIV antibodies. Screening was only carried out in children aged one year and over.

Data were entered in Excel and analyzed using R v 4.4.1 software, with a significance level of 5% (p<0.05).



**Fig 1**: Map of the city of Kara showing the different surveyed sites

**RESULTS**

A total of 1,597 patients were consulted in the course of this fairground activity, of whom 69% (N=1100) [IC95%: 67 to 71] were women. Subjects ranged in age from 1 to 104, with a median age of 43. Subjects aged between 46 and 60 were the most represented, with a percentage of 23% (N=360) [CI95%: 21-25%]. With regard to the origin of the participants, it should be noted that the locality of Djamdè was the most represented, with 26% (N=422) [IC95%: 24-29%] of patients, followed by the locality of Pya with 18% (N=282) [IC95%: 16-20%] of patients. Atchamgbade remains the most under-represented locality in this study, with a proportion of 10% (N=166) [IC95%: 9-12%] (Table 1).

Table 1: Socio-demographic characteristics of the study population

|  | **N = 1597***1* | **95% CI***2* |
| --- | --- | --- |
| **Age** | 43 (21) | [41 ; 44] |
| **Age group** |  |  |
| [0-15] | 189 (12) | [11 - 14] |
| [16-30] | 326 (21) | [19 - 23] |
| [31-45] | 323 (21) | [19 - 23] |
| [46-60] | 360 (23) | [21 - 25] |
| [61-75] | 320 (20) | [18 - 23] |
| [76-90] | 47 (3) | [2.2 - 4] |
| **Sex** |  |  |
| F | 1100 (69) | [67 - 71] |
| M | 492 (31) | [29 - 33] |
| **Area** |  |  |
| Atchamgbade | 166 (10) | [9 - 12] |
| Awandjelo | 255 (16) | [14 - 18] |
| Djamdè | 422 (26) | [24 - 29] |
| Pya | 282 (18) | [16 - 20] |
| Sarakawa | 200 (13) | [11 - 14] |
| Soumdina-bas | 272 (17) | [15 - 19] |
| *1Mean (SD); n (%)* | | |
| *2CI = Confidence Interval* | | |

***Prevalence of HBsAg and anti-HIV antibodies***

Viral co-infections (HIV and HBV) were found in 5 people, one per site.

The prevalence of HBsAg carriage in the study population, all localities combined, was 8.76% (N=140), with 67% women and 33% men. Among positive cases, 3.6% were in the 0-15 age group (N=5). Specifically by locality, the prevalence of HBsAg carriage was 17.5% in Atchamgbadè, 9.8% in Awandjelo, 5.7% in Djamdè, 5.3% in Pya, 8.5% in Sarakawa and 11% in Soumdina (Figure 2A). The prevalence of HBsAg varies by age group. The highest positivity rates are observed among young adults aged **16-30 years 15%** and **31-45 years 13.6%** (Figure 2B).

A total of 1,396 patients were screened for HIV antibodies. The prevalence of anti-HIV-1 antibodies was 3.51%, 82% (N=40) of whom were women and 18% (N=9) men. No positive cases were found in the Atchamgbadè district. Prevalence was 3.1% in Awandjelo, 4.4% in Djamdè, 4.3% in Pya, 3% in Sarakawa and 4% in Soumdina (Figure 2C). The prevalence of HIV antibodies varies by age group, with the highest positivity rates observed in individuals aged **31-45 years 6%, ; 46 à 60 years 6.8%** . No cases were detected in the **16-30** and **76-90 age groups**, while lower prevalence was noted in children **0-15 years 0.74%** and older adults **61-75 years 2.3% (Figure 2D).**

|  |  |
| --- | --- |
|  |  |
|  |  |

**Figure 2**: Prevalence of HBsAg and HIV Antibodies by Socio-Demographic Characteristics Among Survey Participants in Kara, 2024

***Carrying HBsAg***

Univariate analysis revealed risk factors for hepatitis B infection in the study population. Among HBsAg-positive subjects, 35% (N=49) [95% CI: 27-44%] were aged between [16-30] years. There was a significant association between hepatitis B infection and age. Prevalence was higher in subjects aged between [16-30] and [31-45] than in other age groups (p<0.001). Similarly, prevalence was higher in the locality of Atchamgbadè; 21% [CI95% : 15 - 29%] compared to other localities (p<0.001). (Table 2)

**Table 2:** HBsAg carriage according to the demographic characteristics of the study population in 2024

| **Characteristic** | **Overall**  N = 1597*1* | **95% CI***2* | **Negatif**  N = 1457*1* | **95% CI***2* | **Positif**  N = 140*1* | **95% CI***2* | **p-value***3* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Age** |  |  |  |  |  |  | **<0.001** |
| [0-15] | 189 (12) | [11, 14] | 184 (13) | [11, 15] | 5 (3.3) | [1.3, 8.6] |  |
| [16-30] | 326 (21) | [19, 23] | 277 (19) | [17, 22] | 49 (35) | [27, 44] |  |
| [31-45] | 323 (21) | [19, 23] | 279 (20) | [18, 22] | 44 (32) | [24, 40] |  |
| [46-60] | 360 (23) | [21, 25] | 330 (23) | [21, 25] | 30 (22) | [15, 30] |  |
| [61-75] | 320 (20) | [18, 23] | 310 (22) | [20, 24] | 10 (7) | [3.7, 13] |  |
| [76-90] | 47 (3.0) | [2.2, 4.0] | 46 (3.0) | [2.4, 4.3] | 1 (0.7) | [0.04, 4.5] |  |
| **Sex** |  |  |  |  |  |  | 0.6 |
| F | 1100 (69) | [67, 71] | 1007 (69) | [67, 72] | 93 (67) | [58, 75] |  |
| M | 492 (31) | [29, 33] | 446 (31) | [28, 33] | 46 (33) | [25, 42] |  |
| **Area** |  |  |  |  |  |  | **<0.001** |
| Atchamgbadè | 166 (10) | [9.0, 12] | 137 (9.0) | [8.0, 11] | 29 (21) | [15, 29] |  |
| Awandjélo | 255 (16) | [14, 18] | 230 (16) | [14, 18] | 25 (18) | [12, 25] |  |
| Djamdè | 422 (26) | [24, 29] | 398 (27) | [25, 30] | 24 (17) | [12, 25] |  |
| Pya | 282 (18) | [16, 20] | 267 (18) | [16, 20] | 15 (11) | [6.3, 17] |  |
| Sarakawa | 200 (13) | [11, 14] | 183 (13) | [11, 14] | 17 (12) | [7.4, 19] |  |
| Soumdina-bas | 272 (17) | [15, 19] | 242 (17) | [15, 19] | 30 (21) | [15, 29] |  |
| *1*n (%) | | | | | | | |
| *2*CI = Confidence Interval | | | | | | | |
| *3*Pearson's Chi-squared test | | | | | | | |

Multivariate analysis showed that the probability of being positive for hepatitis B was multiplied by 5.92 in people in the [16-30] age bracket compared with those in the [0-15] age bracket, adjusted for sex and locality. This association is statistically significant.

Patients from Atchamgbadè, Soumdina-bas and Sarakawa were respectively 3.05, 2.55 and 2.14 more likely to be hepatitis B positive than their counterparts from Pya, adjusted for sex and age. This association is statistically significant, as the confidence intervals do not contain 1 (Table 3).

**Table 3**: Multivariate analysis of HBsAg carriage based on sex, age, and geographical origin in 2024

| **Characteristic** | **OR***1* | **95% CI2** |
| --- | --- | --- |
| **Age** |  |  |
| [0-15] | — | — |
| [16-30] | 5.92 | [2.47 - 17.6] |
| [31-45] | 5.26 | [2.20 - 15.6] |
| [46-60] | 2.92 | [1.18 - 8.82] |
| [61-75] | 1.08 | [0.37 - 3.57] |
| [76-90] | 0.83 | [0.04 - 5.44] |
| **Sex** |  |  |
| F | — | — |
| M | 1.21 | [0.82 - 1.77] |
| **Area** |  |  |
| Pya | — | — |
| Atchamgbadè | 3.05 | [1.58 - 6.07] |
| Awandjélo | 1.94 | [1.00 - 3.89] |
| Djamdè | 1.22 | [0.62 - 2.47] |
| Sarakawa | 2.14 | [1.02 - 4.53] |
| Soumdina-bas | 2.55 | [1.34 - 5.05] |
| *1OR = Odds Ratio* |  |  |
| *2CI = Confidence Interval* |  |  |

***Anti-HIV antibodies***

Univariate analysis revealed risk factors for HIV infection in the study population. Among SRV-positive subjects, 47% (23/49) [CI95%: 33-65%] were aged between [46-60] years. There was a significant association between HIV infection and age. Prevalence was higher in subjects aged between [31-45] and [46-60] years than in other age groups (p<0.001). (table4)

**Table 4:** Seroprevalence of anti-HIV antibodies according to the demographic characteristics of the study population in 2024.

| **Characteristic** | **Overall**  N = 1447*1* | **95% CI***2* | **Negatif**  N = 1398*1* | **95% CI***2* | **Positif**  N = 49*1* | **95% CI***2* | **p-value***3* |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Age** |  |  |  |  |  |  | **<0.001** |
| [0-15] | 136 (10) | [8.1, 11] | 135 (9.8) | [8.3, 12] | 1 (2.0) | [0.11, 12] |  |
| [16-30] | 297 (21) | [19, 23] | 297 (22) | [20, 24] | 0 (0) | [0.0, 9.1%] |  |
| [31-45] | 300 (21) | [19, 23] | 282 (21) | [18, 23] | 18 (37) | [24, 52] |  |
| [46-60] | 340 (24) | [22, 26] | 317 (23) | [21, 25] | 23 (47) | [33, 62] |  |
| [61-75] | 304 (21) | [19, 24] | 297 (22) | [20, 24] | 7 (14) | [6.4, 28] |  |
| [76-90] | 44 (3.0) | [2.3, 4.2] | 44 (3.2) | [2.4, 4.3] | 0 (0) | [0.0, 9.1] |  |
| **Sex** |  |  |  |  |  |  | 0.11 |
| F | 1015 (70) | [68, 73] | 975 (70) | [67, 72] | 40 (82) | [67, 91] |  |
| M | 430 (30) | [27, 32] | 421 (30) | [28, 33] | 9 (18) | [9.2, 33] |  |
| **Area** |  |  |  |  |  |  | 0.2 |
| Atchamgbadè | 166 (11) | [9.9, 13] | 166 (12) | [10, 14] | 0 (0) | [0.0, 9.1] |  |
| Awandjélo | 255 (18) | [16, 20] | 247 (18) | [16, 20] | 8 (16) | [7.8, 30] |  |
| Djamdè | 272 (19) | [17, 21] | 260 (18.5) | [17, 21] | 12 (24.5) | [14, 39] |  |
| Pya | 282 (19) | [17, 22] | 270 (19) | [17, 22] | 12 (24.5) | [14, 39] |  |
| Sarakawa | 200 (14) | [12, 16] | 194 (14) | [12, 16] | 6 (12) | [5.1, 25] |  |
| Soumdina-bas | 272 (19) | [17, 21] | 261 (18.5) | [17, 21] | 11 (23) | [12, 37] |  |
| *1*n (%) | | | | | | | |
| *2*CI = Confidence Interval | | | | | | | |
| *3*Pearson's Chi-squared test | | | | | | | |

**DISCUSSION**

Viral hepatitis B is highly prevalent in Togo. Our study reported an HBsAg carriage prevalence of 8.76% in the Kara population. This high prevalence confirms Kara's status as an HBV-endemic area according to WHO classification. Moreover, high prevalences had already been reported by other authors in Lomé: 16% by Kolou in 2017 however in Lomé at the capital[11]. Within the 6 villages, we note a high prevalence in the village Atchamgbadè (17.5%; p<0.001). and Soumdina-bas (11%). These two villages are far from the town center, and therefore have a large rural population unaware of public health issues. The same observation was made in Uganda by Ochola in 2023, where the rural population in the north of the country had a higher prevalence than that in the capital[12]. As prevalence is higher among women (67%), the risk of transmission of HBV from mother to newborn is very high. This transmission is known to be the cause of chronic hepatitis B carriage in children infected at birth. Moreover, a study by Ekouevi in Togo in 2017 showed a high proportion (10%) of HBsAg-positive pregnant women [13].

In addition, hepatitis B diagnosis is expensive, which makes it difficult to detect cases of infection in the population and leads to contamination being maintained. Studies carried out in the Gambia and among the migrant population have highlighted the high cost of diagnosing and treating viral hepatitis B, which slows down treatment [14]. Rural populations, who generally have no income-generating activities, have low purchasing power, so their healthcare expenditure is limited to the essentials or the most urgent cases. Indeed, in Uganda, Ochola et al. demonstrated that financial affluence was protective against viral hepatitis B infection [12].

In Togo, various studies carried out on well-targeted populations in the south of the country found prevalences of around 3-5%[15-18,13]. In the general population of Lomé, it was around 16%[9]. Our study therefore shows that prevalence in the northern part of the country was very high. This is also the case in the northern part of Benin, in the town of Parakou, which is close to Kara, with a population sharing the same eating habits, and with fluid traffic between the two countries due to the border. The prevalences obtained among pregnant women and people living with HIV were 9.9%, and among health workers 13.23%. Among the risk factors cited in these studies were scarification and age [19,20]. Age was also reported as a factor associated with HBsAg carriage in our study. These similarities found in these two neighboring cities call for in-depth studies to better understand the transmission of the virus.

HIV was detected in 3.51% of our study population. This rate is higher than the national prevalence of 1.7%[21]. It should be noted that popular belief holds that HIV prevalence in rural African populations is generally lower than in capital cities. However, studies carried out in many rural areas in Africa and elsewhere show the opposite [22-25]. It should be noted that the town of Kara is the second largest in Togo, and is also very busy during the summer months. It is a tourist area. This is remarkable, as the villages closest to the town center were the ones with the highest prevalence, as was the village with the most tourist attractions. Among the risk factors we looked for was age. Prevalence was higher in subjects aged between [31-45] and [46-60] years than in other age groups (p<0.001). A similar trend was reported in Cameroon by Bilong et al. in 2015[26]. While for hepatitis B, the young population was the most contaminated, for HIV, it was the mature population. Indeed, the strategy of putting HIV-positive pregnant women on antiretroviral treatment and follow-up has greatly contributed to the reduction of new infections among young people, as demonstrated by the study carried out by Akapko et al. in 2022[27]. While progress has been made in the management of HIV in pregnant women, it should not be forgotten that, due to the lack of access to healthcare for rural populations, HIV is diagnosed at an advanced age, as Agbeko et al. point out in a study of children in rural Togo[28].

Viral co-infections were detected in only 5 patients in our study. However, a number of studies have highlighted a high proportion of HIV/HBV co-infections[19,29-32] . It should be pointed out, however, that these studies were carried out on PLHIV.

**CONCLUSION**

The prevalence of hepatitis B and human immunodeficiency viruses is fairly high among the population of the town of Kara. The impact of these diseases on quality of life, and the risk of maternal-fetal transmission, need to be taken into account in health actions. Public information and education sessions need to be stepped up. It would also be advisable to carry out studies to detect other markers of the hepatitis B virus in HBsAg-positive patients.

***Ethics approval and consent:***

This project was approved by the regional health director. Consent was obtained from each participant before being enrolled in the study.

**Disclaimer (Artificial intelligence)**

Option 1:

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. Word Health Organization. Global hepatitis report 2024: action for access in low- and middle-income countries [Internet]. 2024 [cited August, 26th 2024]. Available: https://www.who.int/publications/i/item/9789240091672

2. World Health Organization. WHO | Regional Office for Africa. 2024 [cited August, 26th 2024]. HIV/AIDS. Available: https://www.afro.who.int/health-topics/hivaids

3. World Health Organization. Mother-to-child transmission of HIV [Internet]. [cited 3rd sept 2023]. Available sur: https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/hiv/prevention/mother-to-child-transmission-of-hiv

4. World Health Organization. Hepatitis: Preventing mother-to-child transmission of the hepatitis B virus [Internet]. 2020 [cited August 2024]. Available: https://www.who.int/news-room/questions-and-answers/item/hepatitis-preventing-mother-to-child-transmission-of-the-hepatitis-b-virus

5. World Health Organization. WHO | Regional Office for Africa. 2022 [cited Oct18th 2022]. 91 million Africans infected with hepatitis B or C. Available: https://www.afro.who.int/fr/news/91-millions-dafricains-infectes-par-lhepatite-b-ou-c

6. UNAIDS. Full report — In Danger: UNAIDS Global AIDS Update 2022 | UNAIDS [Internet]. 2024 [cited august, 27th 2024]. Available: https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update

7. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: A Cancer Journal for Clinicians [Internet]. 2024 [cited august, 27th 2024];74(3):229‑63. Available: https://onlinelibrary.wiley.com/doi/abs/10.3322/caac.21834

8. Kolou M, Katawa G, Salou M, Gozo-Akakpo KS, Dossim S, Kwarteng A, et al. High Prevalence of Hepatitis B Virus Infection in the Age Range of 20-39 Years Old Individuals in Lome. Open Virol J [Internet]. 12th jan 2017 [cited 2nd oct 2019];11:1‑7. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5301296/

9. Kolou M, Nadjir LK, Anyovi F, Katawa G, Abaltou B, Salou M. Seroprevalence of viral hepatitis B and C in the general population of Lome. Journal of Scientific Research of the University of Lomé [Internet]. 2018 [cited 18th Oct 2022];20(1):225‑33. Available: https://www.ajol.info/index.php/jrsul/article/view/179252

10. Gbeasor-Komlanvi FA, Zida-Compaore WIC, Sadio AJ, Tchankoni MK, Kadangha BM, Salou M, et al. HIV testing uptake and prevalence among hospitalized older adults in Togo: A cross-sectional study. PLoS ONE [Internet]. 2021 [cited 27th august 2024];16(2):e0246151. Available: https://hal.science/hal-03188569

11. Kolou M, Katawa G, Salou M, Gozo-Akakpo KS, Dossim S, Kwarteng A, et al. High Prevalence of Hepatitis B Virus Infection in the Age Range of 20-39 Years Old Individuals in Lome. Open Virol J. 2017;11:1‑7.

12. Ochola E, Ocama P, Orach CG, Nankinga ZK, Kalyango JN, McFarland W, et al. High burden of hepatitis B infection in Northern Uganda: results of a population-based survey. BMC Public Health [Internet]. dec 2013 [cited 7th jan 2025];13(1):1‑7. Available: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-13-727

13. Ekouevi DK, Larrouy L, Gbeasor-Komlanvi FA, Mackiewicz V, Tchankoni MK, Bitty-Anderson AM, et al. Prevalence of hepatitis B among childbearing women and infant born to HBV-positive mothers in Togo. BMC Infect Dis. 12th nov 2020;20(1):839.

14. Cost-effectiveness of community-based screening and treatment for chronic hepatitis B in The Gambia: an economic modelling analysis - The Lancet Global Health [Internet]. [cited 7th jan 2025]. Available: https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(16)30101-2/fulltext

15. Ekouevi DK, Thomas A, Sewu D, Lawson-Ananissoh L, Tchounga B, Salou M, et al. Prevalence of Hepatitis B among Students from the University of Lomé, Togo in 2015. Open Journal of Epidemiology [Internet]. 8 août 2017 [cited 12th dec 2022];7(3):262‑72. Disponible sur: http://www.scirp.org/Journal/Paperabs.aspx?paperid=78614

16. Ekouevi DK, Coffie PA, Salou M, Kariyiare BG, Dagnra AC, Tchounga B, et al. HIV Seroprevalence among Drug Users in Togo. Sante Publique [Internet]. 4th oct 2013 [cited 22th march 2023];25(4):491‑8. Available sur: https://www.cairn-int.info/article.php?ID\_ARTICLE=E\_SPUB\_134\_0491

17. Tete-Benissan A, Degbe M, Salami-Osseni A, Godonou M, Aklikokokou K, Gbeassor M. Epidemiology of viral hepatitis B among the Ogo of Togo: prevalence and serological markers. Journal of Scientific Research of the University of Lomé [Internet]. 2018 [cited 13th Oct 2022];20(3):89‑102. Available: https://www.ajol.info/index.php/jrsul/article/view/183067

18. Sadio AJ, Kouanfack HR, Dagnra AC, Amenyah-Ehlan AP, Ferré VM, Descamps D, et al. Hepatitis B and C among street adolescents in Togo in 2021: prevalence and vaccination profile. Journal of Epidemiology and Public Health [Internet]. 1st Sept 2023 [cited 7th Jan 2025];71:101917. Available: https://www.sciencedirect.com/science/article/pii/S0398762023005023

19. Dovonou CA, Amidou SA, Kpangon AA, Traoré YA, Martial TP, Satondji AJ, et al. Prevalence of hepatitis B among HIV-infected individuals in Parakou, Benin. Pan Afr Med J [Internet]. 2015 [cited 23rd Aug 2024];20. Available: http://www.panafrican-med-journal.com/content/article/20/125/full/

20. C.D. Fanou, R. Klipkezo, K. Sake, F. Zinsou, U. Haag, J. Attinon, et al. Séroprévalence et facteurs associés à l’hépatite virale B chez les agents de santé à Parakou (République du Bénin). APIDPM Santé tropicale [Internet]. aug 2022 [cited 23th jan 2025];6909:495‑502. Available: https://www.santetropicale.com/manelec/fr/https%3A%2F%2Fwww%2Esantetropicale%2Ecom%2Fmanelec%2Ffr%2Fresume%5Foa%2Easp%3Fid%5Farticle%3D3585

21. National Program to Combat HIV/AIDS, Viral Hepatitis and Sexually Transmitted Infections (PNLS-HV-IST). 2023 Annual Report of PNLS-HV\_IST Activities. 2024. Available: https://cnlstogo.org/cnls/

22. González R, Munguambe K, Aponte J, Bavo C, Nhalungo D, Macete E, et al. High HIV prevalence in a southern semi-rural area of Mozambique: a community-based survey. HIV Medicine [Internet]. 2012 [cited 25th jan 2025];13(10):581‑8. Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-1293.2012.01018.x

23. Lincoln Priyardashi Choudury, Jayaraman Prabakaran. Urban and Rural HIV Estimates among Adult Population (15 - 49 Years) in Selected States of India Using Spectrum Data. World Journal of AIDS [Internet]. 2015 [cited 25th jan 2025];5(3):226‑37. Available: https://www.scirp.org/journal/paperinformation?paperid=59925

24. Sowell RL, Christensen P. HIV INFECTION IN RURAL COMMUNITIES. Nursing Clinics of North America [Internet]. 1st march 1996 [cited 25th jan 2025];31(1):107‑23. Available: https://www.sciencedirect.com/science/article/pii/S0029646522003929

25. Gneragbe T, Mutombo T. SIDA en milieu rural : cas de Dabou et environs. Médecine et Maladies Infectieuses [Internet]. 1st jun 1994 [cited 27th jan 2025];24(6):802‑3. Available: https://www.sciencedirect.com/science/article/pii/S0399077X05803464

26. Billong SC, Fokam J, Billong EJ, Nguefack-Tsague G, Essi MJ, Fodjo R, et al. Epidemiological distribution of HIV infection among pregnant women in the ten regions of Cameroon and strategic implications for prevention programs. The Pan African Medical Journal [Internet]. 29th Jan 2015 [cited 27th Jan 2025];20:79. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC4450023/

27. Akakpo AS, Larabou A, Saka B, Téclessou JN, Singo A, Dagnra A, et al. Trends in HIV and syphilis prevalence among pregnant women attending antenatal clinics in Togo: Analysis of sentinel serosurveillance results between 2008 and 2016. Tropical Medicine and International Health [Internet]. 13th Jul 2022 [cited 27th Jan 2025];2(3):mtsi.v2i3.2022.152. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC9557824/

28. Agbeko F, ​​Takassi OE, Segbedji K a. R, Fiawoo M, Tchagbele OB, Guedehoussou T, et al. HIV infection in children in rural areas of Togo. Journal of Scientific Research of the University of Lomé [Internet]. 25th Jul 2017 [cited 27th Jan 2025];19(1):343-52. Available at: https://www.ajol.info/index.php/jrsul/article/view/159093

29. Ouedraogo MS, Bara/Tiendrebeogo S, Tapsoba PG, Korsaga/Some N, Ouedraogo AN, Tiendrebeogo L, et al. CO 13: HIV/Hepatitis B and C coinfection in people living with HIV in an associative medical care structure in the city of Ouagadougou (BURKINA FASO). Annals of Dermatology and Venereology [Internet]. 1st Apr 2016 [cited 28th Jan 2025];143(4, Supplement 1):S25. Available: https://www.sciencedirect.com/science/article/pii/S0151963816301405

30. Kaya-Soukho A, Traoré AM, Soumaré G, Dabo G, Sy D, Koné SA, et al. Current epidemio-clinical profile of HBV/HIV and HCV/HIV coinfections at the Point-G University Hospital, Bamako, Mali. Journal of Scientific Research of the University of Lomé [Internet]. 6th Nov 2020 [cited 27th Jan 2025];22(1‑2):219‑27. Available: https://www.ajol.info/index.php/jrsul/article/view/201371

31. Rakotozafindrabe ALR, Andriamifidison RN, Rabenjanahary T, Razafimahefa SH, Rakotoarivelo R, Randria MJD, et al. Prevalence of coinfection with human immunodeficiency virus and hepatitis B and hepatitis C viruses: A multicenter study in Madagascar. J Afr Hepato Gastroenterol [Internet]. 1 June 2017 [cited 28 January 2025];11(2):52-7. Available: https://doi.org/10.1007/s12157-016-0696-y

32. Amidou SA, Dovonou CA, Houehanou C, Kpangon AA, Ahanhanzo-Glele R, Kpangon JH, et al. Prevalence of chronic hepatitis B according to HIV status in Parakou, Benin. Pan Afr Med J [Internet]. 27th Jun 2018 [cited 28th Jan 2025];30:180. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6235507/