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Hepatitis B and C Immunological and Molecular Parameter Analysis in HIV-Positive Patients Undergoing Antiretroviral Therapy at Saint Camille Hospital in Ouagadougou (HOSCO), Burkina Faso

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Abstract

Knowledge of the clinical and biological profile of patients infected with HIV and hepatitis B and/or C is essential in order to identify and implement effective management strategies. ***Methods***: This was a retrospective descriptive study from January 01, 2016 to June 01, 2021. Adult patients aged at least 18 years infected with HIV type 1 and/or 2, naïve to ARV treatment. Univariate analyses were assessed using Pearson's Chi2 test. The Student Newman test was used for comparison between groups using R software version 4.0.2. ***Objective***: To draw up the epidemiological, clinical, paraclinical and evolutionary profiles of HIV-treated-patients in relation to HIV/HBV and HIV/HCV co-infections in order to allow the identification and the implementation of effective management strategies. ***Results***: Of the 379 patients included 280

(73.88%) were women. At treatment initiation, the mean age was 40.14 ± 11.84 years. The majority of patients consulted at WHO stage III (51.45%). Clinical suspicion was the most frequent screening circumstance (51.71%). The pathologies frequently reported at the first consultation were diarrhea (28%) and shingles (16%). Body mass index was normal in 50.5% of patients. HIV1 infection was the majority (91.03%). A total of 270 had a CD4 count at treatment initiation. The mean CD4 cell count was 304.17 ± 242.06 cells/μL, and 116 (42.59%) of them had a CD4 ≤ 200 cells/μL. Viral load at treatment initiation was documented in 62 patients (16.35%) and 70.97% of them had a detectable viral load (greater than 1000 copies/mL). The clinical and biological evolution was relatively good in patients after therapeutic initiation. HIV-HBV co-infection was 24.11% and HIV-HCV co-infection was 2.26%. The mortality rate was 3.69%. ***Conclusion***: These results reflect a significant delay in HIV infection diagnosis. Furthermore, hepatitis B and/or C is co-infections that increasingly affect people living with HIV. It also appears that COVID 19 disease has had a strong impact on patient management. Thus, new screening strategies must be implemented to encourage early diagnosis of HIV, hepatitis B and C. Effective strategies are also necessary to fight HIV in the context of epidemics and/or pandemics.

Keywords

HIV, Clinical-Biological Profile, Hepatitis B and C, Co-Infection, Burkina Faso

1. Introduction

Human immunodeficiency Virus (HIV), Hepatitis B virus (HBV), and Hepatitis C virus (HCV), are the three most common chronic viral infections all over the world. They share similar transmission routes including sexual, blood-blood contact, and injecting drug usage [1]. Co-infection with HIV and HCV and/or HBV is very common in certain populations, such as intravenous drug users (IDUs) who often share the contaminated needles/syringes for intravenous drug injection. The rates of HIV-HBV co-infection are reported as high as 10% - 20% in countries where HBV infection is either endemic or intermediate to high HBV cases. It has been observed that HBV/HIV co infection leads to increased morbidity and mortality as compared to HIV or HBV mono-infections [2]. The ever increasing burden of these infections has become a growing concern [3]. With increased access to antiretroviral drugs for HIV patients, migrating populations and social networking by intravenous drug use, cases of HBV and HCV co infections have been on the rise [4]. Studies show that HIV co infection adversely impacts on the natural history of HBV and HCV [4] by accelerating progression to chronic liver disease due to drug-related hepatotoxicity and hepatitis reactivation [5] [6]. At this stage, most patients are likely to die due to liv-

er-related diseases compared to those without HIV infection [7]. Viral hepatitis is a global health challenge worldwide, particularly in low and middle-income countries [8]. In Africa, hepatitis B virus (HBV) is estimated to affect around 75 million people including 1.9 million in Burkina Faso [9]. The prevalence of HBV and HCV was still high in African countries: in fact, 12.2% HBV prevalence in Nigeria [10]; an overall prevalence of HBsAg of 30.9% in Cote d'Ivoire [11]; and 12.4% in Burkina Faso [12] versus 9.1% [13]. In Senegal prevalence of HBsAg in the general population was 8.1% in 2016 [14]. HCV prevalence is estimated to 2.8% in Kenya, 3.2% in Ghana, 4.9% in Cameroon and, finally, 6.1% in Burkina Faso [15]. The rate of co-infection between HCV and HIV was also high [16].

In short, hepatitis B and C viruses and HIV constitute major problems in the Burkinabé health system [17]. The prevalence of HIV infection in the adult population of Burkina Faso is estimated at 0.70% in 2019 against 0.9% in 2014 and 1% in 2012, with a large predominance of HIV 1 [18]. In practice, studies highlight the impact of these viral infections on the capacity of transfusion blood in the country, HIV 1 is 1% and hepatitis C is 5%. So, viral hepatitis infection is the most common in the country, but it is silent and shows no signs. This implies a particular danger in a country where the prevalence of HIV AIDS is not negligible, these viruses sharing the same routes of contamination as HIV. Faced with the alarming situation caused by these hepatitis viruses in Burkina Faso, the general objective of the present study was to determine the seroprevalences of antibodies against hepatitis B and C viruses and to analyze the impact of the immunological and molecular parameters of these viral hepatitis in HIV-positive patients under antiretroviral treatment (ART), at the Saint Camille Hospital in Ouagadougou (HOSCO), Burkina Faso.

2. Methodology

2.1. Framework of the Study

The study was conducted in the city of Ouagadougou, the political capital of Burkina Faso, and at the Prevention of Mother-to-Child Transmission (PMTCT) unit of the Saint Camille Hospital in Ouagadougou.

2.2. Type and Period of Study

This is a descriptive and analytical cross-sectional study with retrospective data collection. It covered the period from 01st January 2016 to 01st June 2021. During the study period, 504 patients started antiretroviral treatment in the active file of which 379 patients met the inclusion criteria.

2.3. Study Population

A total of 379 patients, whose clinical records were available for the study period were included. Inclusion criteria were HIV1 and/or HIV2 infection and follow-up in the active file of the PMTCT service. Patients transferred to the Day

Hospital, under antiretroviral treatment were excluded from the study.

2.4. Data Collection Survey

For data collection, a collection form was developed. This data collection consisted of a review of the clinical files of PLHIV who are followed up at the HOSCO and the recording of parameters of interest. We sorted the files concerned for our study and filled out the data collection forms.

2.5. Statistical Analysis of Data

Data were entered into Excel 2016 and then analyzed using R software version 4.0.2. Prevalences were calculated with 95% confidence intervals (95% CI). Differences between prevalences, different age groups and CD4 counts, were assessed using Pearson's Chi2 test. The Student Newman test was used for comparison between groups with R software version 4.0.2. Results with $p < 0.05$ were considered statistically significant.

2.6. Ethical Considerations

This study was conducted in the context of routine care. All information collected was kept strictly confidential and patient names were not included in the exported data. The study had the approval of the institutional ethics committee of the HOSCO.

3. Results

3.1. Socio-Demographic Characteristics

The majority of patients were female, with 280 women (73.88%), giving a male/female sex ratio of 0.35. The mean age was 40.14 ± 11.84 years with extremes of 18 and 81 years. The most represented age group was 35 - 44 years with a frequency of 31.66%. The distribution of patients according to their socio-professional activity revealed a high proportion of unemployed (31.66%) and among these, housewives were the most represented (25.65%). There were 22.96% of traders, 8.71% of students, 4.49% of farmers and 1.85% of civil servants. According to the area of residence, patients living in urban areas were the most represented in the study population (96.04%) and the majority of them, 93.93%, came from the city of Ouagadougou, compared to 3.43% from rural areas. The area of origin was not specified for two (02) patients (0.52%). Patients in couples represented 56.21% of the study population with a predominance of monogamous married patients (38.79%) and 7.92 of polygamous patients. Single patients were 27.7%, widowed 11.87%, cohabiting 9.7% and divorced 4.22%. The level of education was specified for 361 patients, *i.e.* 95.25% of the patients included. The majority of patients (35.09%) had no schooling and only 11.35% of patients had attained higher education, 29.29 secondary education and 19.53 primary education. These results on the level of education specify a statistically significant difference with the value of $p < 0.001$. A large proportion (32%) of the

patients included in the study had informed their sexual partner about their serological status. This parameter was not applicable in the majority (30%) (Table 1).

3.2. Patients' Clinical and Biological Characteristics at Initiation and Under Antiretroviral Treatment

3.2.1. Evolution of Clinical Characteristics

1) *Non-HIV history*

Table 1. Socio-demographic characteristics of the study population.

	Effective	Percentage
Sexe		
Female	280	73.88%
Male	99	26.12%
Socio-professional activity		
Unemployed	120	31.66 %
Students	33	8.71%
Farmers	17	4.49%
Civil servants	7	1.85%
Traders	87	22.96%
Retirees	3	0.79%
Area of residence		
Urban areas	364	96.04%
Rural areas	13	3.43%
Marital status		
Monogamous married	147	38.79%
Polygamous married	30	7.92 %
Singles	105	27.7%
Widowed	44	11.87%
Cohabiting	37	9.7%
Divorced	16	4.22%.
Level of education		
No schooling	133	35.09%
Higher education	43	11.35%
Secondary education	111	29.29%
Primary education	74	19.53%
Information to the sexual partner		
Sexual partner informed	123	32%
Sexual partner not informed	112	30%
Not applicable	144	38%

Non-HIV related history was diabetes and hypertension. Hypertension was a history in 9 patients of whom 8 were on treatment. Also, 3 patients or 0.79% had diabetes and 2 of them were on treatment. The association of hypertension and diabetes was recorded in 1 patient. There was no statistically significant difference (p-value > 0.05) between the initiation of antihypertensive treatment and the initiation of antidiabetic treatment (Table 2).

2) *Circumstances of screening*

Table 3 provides information on the screening circumstances of the patients in the study. Clinical suspicion was the most frequent screening circumstance with 51.71% of cases (p-value < 2.2e−16).

3) *WHO stage*

WHO clinical stage III was higher (p-value < 2.2e−16) than the other stages and accounted for 51.45% of the cases, followed by clinical stage I (33.77%). This

Table 2. Frequency of patients according to their history.

	Incidence of past service history (%)			
	HTA	Diabetes	HTA/Diabetes	P-value
Diseased patient	9/379 (2.37%)	3/379 (0.79%)	1/379 (0.26%)	0.01951
Under treatment	8/9 (88.89%)	2/3 (66.67%)	1/1 (100%)	0.9547

$p < 0.05$.

Table 3. Distribution of patients according to the circumstance of discovery of their status, WHO clinical stages and BMI at initiation.

Circumstances of discovery	**Frequency (%)**	**P-value**
Voluntary screening	98/379 (5.86%)	
PMTCT	56/379 (14.78%)	**<2.2e−16**
Diagnosis/Clinical suspicion	196/379 (51.71%)	
Not specified	29/379 (7.65%)	
	WHO clinical stage	
Stage I (asymptomatic)	128/379 (33.77%)	
Stage II (moderate)	49/379 (12.93%)	**<2.2e−16**
Stage III (advanced)	195/379 (51.45%)	
Stage IV (severe)	28/379 (7.39%)	
	Body Mass Index (BMI) (Kg/m²)	
<18.5	60/303 (19.8%)	
18.5 ≤ BMI 0 < 25	153/303 (50.5%)	**<2.2e−16**
25 ≤ BMI 0 < 30	48/303 (15.84%)	
≥30	42/303 (13.86%)	

$p < 0.05$.

difference between clinical stages was also statistically significant. Table 3 shows also the distribution of patients according to their WHO clinical stage at inclusion.

4) *Body mass index* (*BMI*) *evolution*

BMI was assessed in 303 patients or 79.95% of the population. Before treatment, the mean BMI was 23.14 ± 5.7 kg/m^2 and slightly more than half of the patients or 50.5% had a normal BMI with a significance of results p < 2.2e−16 (Table 3). Compared to data after the treatment, we observed a progressive weight gain of the patients after they started ART (Figure 1).

5) *Evolution of clinical events*

The clinical events at ARV treatment initiation were reported in 102 patients or 26.91% of the study population. These clinical events after ART initiation were dominated by diarrhea and herpes zoster with 28% and 16% respectively. These differences were statistically significant at p = 2.56e−08 (Table 4). They changed under treatment. In fact, the number of clinical events decreased during follow-up. Indeed, of the 102 patients presenting a clinical event at the beginning of treatment, only 38 (10.03% of the study population) presented a clinical failure during treatment.

3.2.2. Evolution of Biological Data

1) *Type of HIV*

HIV 1 infection was the majority in the study population and concerned 345 patients or 91.03% (345/379) and HIV 2 was 4.22% (16/379). Co-infection between HIV1 and 2 was 4.75% (18/379). The differences between results were highly significant p ≤ 2.2e−16.

Table 4. Distribution of clinical events in patients after initiation.

Clinical event	Frequency (%)	p-value
Diarrhea	28/100 (28%)	
Tuberculosis	7/100 (7%)	
Prurigo	8/100 (8%)	
Zona	16/100 (16%)	
Weight loss	8/100 (8%)	
Herpes	2/100 (2%)	
Mycosis	6/100 (6%)	**2.56e−08**
Pneumocystis	2/100 (2%)	
Community-acquired pneumonia	4/100 (4%)	
Candidiasis	6/100 (6%)	
Dermatosis	9/100 (9%)	
Others	4/100 (4%)	
Total	**100/100 (100%)**	

p < 0.05.

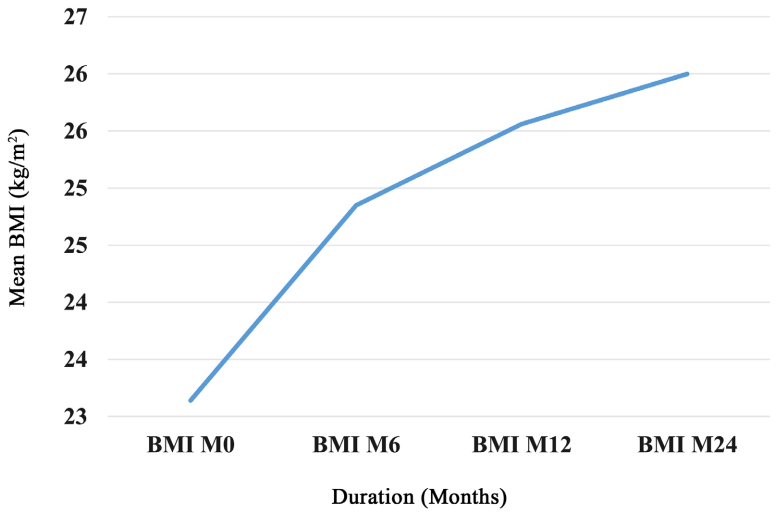

Figure 1. BMI changes after ART initiation. Legend: BMI = body mass index; M0 = month 0, M6 = 6 months, M12 = 12 months, M24 = 24 months.

2) *CD4 evolution after initiation of ARV treatment*

The initial CD4 quantification was performed for 270 patients. We found 71.24% of the study population at treatment initiation with a mean CD4 count of 304.17 ± 242.06 cells/μL, the extremes ranging from 1 to 1286 cells/μL. The majority of patients (42.59%) had CD4 counts below 200 cells/μL. They gained under treatment. **Figure 2** shows the evolution of patients' CD4 lymphocytes according to the duration of treatment. The gain in CD4 was regular in patients after initiation of treatment. The plateau was reached rapidly with stabilization after 12 months of treatment and return to near normal CD4 values. Under treatment, 12.14% of patients experienced immunological failure.

3) *Evolution of the viral load after initiation of ARV treatment*

The viral load at initiation of therapy was documented in only 62 patients or 16.35% of patients and 70.97% had a detectable viral load (greater than 1000). The differences observed between the viral load groups are statistically significant with p = 0.0103. Notable changes have been noted after treatment and during treatments. Indeed, a large majority of patients (91.25%) who started treatment had an undetectable viral load after 6 months of follow-up compared to 82.76% after 12 months. Virological failure was reported in 11.08% of patients on ARV treatment. The data are shown in **Figure 3**.

4) *Biochemical parameters*

Alanine aminotransferase (ALT) value was recorded in 300 (68.60%) patients. The median was 21. UI/l with extremes of 0 and 355.7 and the mean was 28.58 ± 28.83 UI/l. Values were normal in 97.09% of patients. The mean of aspartate aminotransferase (ASAT) was 34.83 ± 28.05 UI/l with extremes of 6.2 and 350.2 UI/l. Blood glucose values were not informed in 40.63% of our patients. The mean was 5.06 ± 2.24 IU mmol/L; and most of our patients, 95.45% had normal blood glucose levels. The mean hemoglobin level at therapeutic initiation was 11.62 ± 1.99 g/dL with extremes ranging from 6 to 17.7 g/dl and a median of

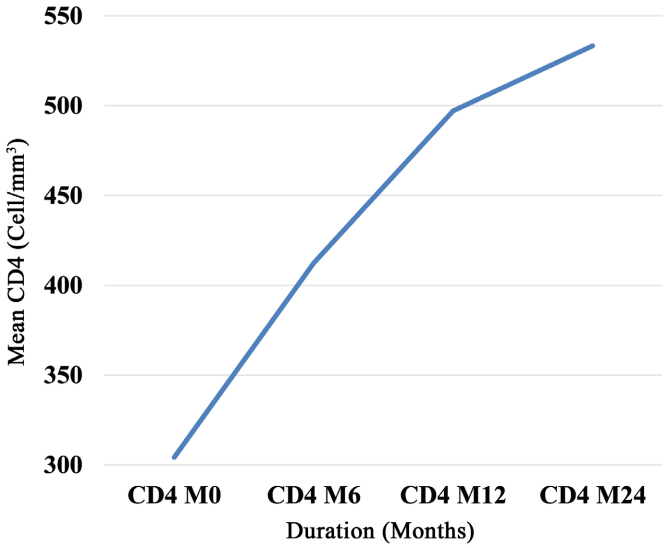

Figure 2. Changes in CD4 count as a function of follow-up time. Legend: TCD4 = TCD4 lymphocytes; M0 = month 0, M6 = 6 months, M12 = 12 months, M24 = 24 months.

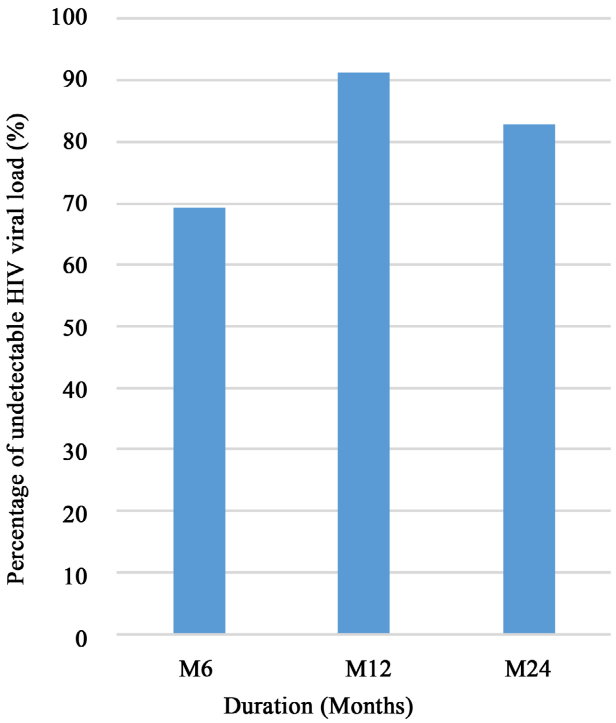

Figure 3. Percentage of undetectable HIV viral loads during follow-up. Legend: M6 = 6 months, M12 = 12 months, M24 = 24 months.

11.6 g/dl; 127 patients (40.32%) were anemic of which only 01 had severe anemia. The mean creatinine clearance was 97.7 ± 27.98 mL/min; 11.08% of the patients had a clearance below normal (90 mL/min).

5) *Hepatitis B and C serology*

Hepatitis B serology was performed in 141 patients (37.2% of the study population); among them, thirty-four (34) or (24.11%) were HBsAg positive. Among these 141 patients, only 26 and 21 patients tested respectively for anti-HBc and anti-HBsAg and the results were positive in 8 and 1 of them respectively. In addition, HBeAg was positive in 2 of 12 patients tested and viral DNA in 3 of 5 patients tested. Hepatitis C serology was performed in 78 patients (20.58% of the study population); among them, 02 (2.26%) were positive for anti-HCV Ac. Viral RNA was not tested in any of the patients. Table 5 shows the distribution of patients according to hepatitis B and C serology at treatment initiation.

6) *HIV, HBV and HCV co-infection*

From the Venn diagram, it appears that the probability of HIV/HBV co-infection was high and estimated at 0.29% or 29.90%, that of HBV/HCV co-infection was low (0.0093% or 0.93%) and that of HIV/HCV co-infection was zero (0%). Also, the probability of triple HIV/HBV/HCV co-infection was low and 0.0093% or 0.93%. Furthermore, the probability of being infected with HIV and/or HBV and/or HCV was null if the patient had arterial hypertension.

7) *First-line treatment*

In the study population, patients who started their antiretroviral treatment according to the 2INTI + 1INNTI regimen were statistically higher (p-value < 2.2e−16), *i.e.* a frequency of 73.35%, with a predominance of the TDF-3TC-EFV protocol (45.9%), followed by the 2INTI + 1INI (TDF-3TC-DTG) regimen, which accounted for 22.96%. Among the 34 HBsAg patients, 11 were followed in parallel by a gastrologist and 100% had TDF in their treatment regimen according to WHO recommendations. After initiation of treatment, 9.76% of the patients experienced treatment failure requiring a change in the treatment regimen. Table 6 shows the distribution of patients according to their first-line treatment regimen.

Table 5. Distribution by hepatitis B and C serology.

Type	Modality	Positive/Tested
	HBsAg	24.11% (34/141)
	AcAntiHBs	4.76% (1/21)
	AgHBe	16.67% (2/12)
HBV		
	AcAntiHBe	75% (3/4)
	AcAntiHBc	30.77% (8/26)
	viral DNA	60% (3/5)
	AcAntiHCV	2.26% (2/78)
HCV		
	viral RNA	None

Table 6. Distribution of patients according to their treatment regimen at initiation of treatment.

Treatment regimen	Frequency (%)	P-value
2INTI + 1INNTI	278/379 (73.35)	
2INTI + 1INI	87/379 (22.96)	<2.2e−16
2INTI + 1IP/r	14/379 (3.69)	
Total	379/379 (100)	

$p < 0.05$.

8) *Patient outcomes*

Retention in the active file of the study population was 75.2%. The mortality rate was 3.69%. The following table shows the outcome of the patients included in the study. With a p-value of 2.2e−16 indicating significant differences (**Table 7**).

4. Discussion

The present study included 280 women or 73.88% of the total population. This gives an M/F sex and West Africa. Thus, in Benin, Amidou *et al.* (2018) found 65.1% the same female trend in their study [19]. This female predominance found in the study populations is a reflection of the feminization of HIV infection in Africa where 58% of HIV positive women are found out of the total of sub-Saharan Africa [17]. This feminization of HIV infection in Burkina Faso could be explained by a much higher use of health services by women. This feminization of HIV infection in Burkina Faso could be explained by a much greater use of health services by women. Moreover, Burkina Faso has emphasized PMTCT, which allows many pregnant women to be screened. Also according to the national committee for the fight against HIV, the general population of Burkina Faso is mostly female (51.7%) [18]. In addition, many factors favor women's vulnerability to HIV infection, compared to men who are protected by circumcision, anatomical factors; physiological (the vagina due to its large surface and fragility facilitates the penetration of the virus, as well as the frequency of STIs); socio-cultural factors (sexual activity tends to be early in women and generally with older partners) [17]. This study revealed that the average age of patients was 40.14 ± 11.84 years with extremes of 18 and 81 years. The most represented age groups were 35 - 45 years with a frequency of 31.66%. HIV affects the most active portion of the population [18] [19] [20] [21]. Indeed, HIV+ patients' age was from 25 to 52 years with an average of 32.0 ± 7.8 in this study in Burkina Faso [22]. Unemployed patients were the most represented 31.66% and housewives constituted the major (25.65%). The majority of our study population (96.06%), resided in urban areas and only (3.94%) resided in rural areas. Moreover, a large proportion of them (93.93%) were from the city of Ouagadougou where the study was conducted. These results probably reflect the policy of decentralization of care for people living with HIV promoted by Burkina Faso.

Table 7. Patient outcomes.

Patient outcome	Workforce	Frequency (%)	P-value
Deceased	14	3.69	
Active file	285	75.2	
			<2.2e−16
Lost and Found	66	17.41	
Transferred	14	3.69	
Total	**379**	**100**	

$p < 0.05$.

Patients in couples made up 56.21% of the population, 46.71% of whom were married. These results are similar to those of other authors in Africa [19] [20] [22] [23]. The majority (35.09%) were uneducated and only 11.35% of the patients had attained tertiary education. These results could be explained by the fact that sub-Saharan Africa records one of the lowest school enrolment rates in the world with large gender disparities [24]. Burkina Faso in particular noted in 2020, a gross enrolment rate at 64.9% [25]. The percentage of notification to sexual partners in our study was only 32%. These data corroborate those of the Keneya project which indicate that by the end of August 2015, 32% of 4106 HIV PLWHA who received care and support services in the health districts of Bouaké North-West and Korhogo had effectively notified their HIV status to their partners [26]. Thus, notification of HIV status and testing of sexual partners of HIV-PVs continues to be a challenge due to a number of apprehensions faced by HIV-positive people, including stigma, domestic violence, or fear of the relationship ending.

The prevalence of hypertension was 2.37%. Arterial hypertension among HIV PLWHA in the world [27] and in Bobo Dioulasso [28] was higher respectively 23.6% and 39.8%. This difference could be explained by the lack of data on the blood pressure figures of the patients included in our study. In the present study, clinical suspicion was the most frequent screening circumstance with 51.71% of cases. Pitroipa *et al.* (2013) and Sanon *et al.* (2014) in Bobo Dioulasso reported screening percentages following clinical suspicion of 68.2% and 70.5% [20] [21]. Some authors reported higher rates of discovery of the disease after clinical suspicion; in DRC 78.1% [29] and 96.3% in Benin [30]. On the other hand, Fonquernie *et al.* (2006), Kilaru (2004), Adamou *et al.* (2010) reported much lower rates respectively 23%, 57.6% and 41.7% [31] [32] [33]. This high rate in our study could be explained by an early detection policy that is still insufficiently encouraging, illiteracy, and a strong fear of stigmatization and discrimination on the part of our populations [34] [35]. WHO III clinical stage was statistically higher 51.45% of cases (p-value < 2.2e−16). Elsewhere, in resource-limited countries, the majority of patients are recruited at stages 3 or 4 in Burkina Faso [20] [21] [30]. The low attendance of health centers by the population and the

non-systematic screening for HIV infection could explain these results. The average BMI in our study population was 23.14 ± 5.7 kg/m^2 and 50.5% had a normal BMI. Ilboudo (2013) reported that 53.2%) of patients had normal or above normal BMI and Sanon *et al.* (2014) 18.5 kg/m^2 (64%) [21] [36]. Clinical events after ART initiation were dominated by diarrhea and herpes zoster with 28% and 16% respectively. Clinical events were also dominated by diarrhea (29%) [20]. The weak immune system favors these small infections. Moreover, HIV-l was the largely predominant serotype and concerned 345 patients or 91.03%. Sanon *et al.* (2014) and Ilboudo (2013) found respectively and 94.7% and 93% of predominance to HIV1 [21] [36]. This distribution of serotypes is perfectly characteristic of our country [18] and in the sub-region, in Côte d'Ivoire, Mali, Ghana where a predominance of HIV-l was noted respectively 97%, 88.4%, and 99.3% [37] [38]. At treatment initiation the mean CD4 T cell count was 304.17 ± 242.06 cells/μL with extremes ranging from 1 to 1286. The majority of patients (42.59%) had a CD4 count below 200 cells/μL. These results are comparable to other authors in Africa [30]. This could be explained by late detection and late [23] [30]. And or often inappropriate, management; some patients with HIV infection are managed by traditional medicine or by prayer houses. Poverty, ignorance but also stigmatization of the patients would delay a quick treatment noted similar results, with 60.4% of patients having less than 200 cells/ μL. In contrast, in developed countries, in France, the median number was 374 cells/μL and slightly more than half of patients had more than 350 cells/μL [31]. In Bordeaux, Costa reported that 73.4% of patients had a CD4 count of over 350 cells/μL) [39]. The same finding in Nigeria where the median CD4 count was 478 cells/μL [40]. As access to care is easier in developed countries, this could explain why patients are detected at an earlier stage of the disease.

The viral load at therapeutic initiation was documented in only 62 patients, 16.35% of our population, and 70.97% of patients had a detectable viral load (greater than 1000 copies/mL). On the other hand, Costa in Bordeaux noted a prevalence of undetectable viral load of 81.2% (less than 1000 copies/mL). This difference could be explained by the precariousness of the health services in Africa but also by the insufficiency of the available data on the viral load (VC) at the therapeutic initiation. Indeed, in Africa, the accessibility of the initial viral load is difficult because of its rarity. Also, many patients who are not compliant enough do not carry out the prescribed tests.

In relation to viral hepatitis serology, 24.11% or 34 patients were HBsAg positive. This result certainly does not reflect the real prevalence of co-infection in our population, as only 141 patients out of 379 were tested. Given the high costs, only patients with symptoms suggestive of hepatitis are tested. It is therefore more than necessary to facilitate the access to the realization of these examinations to this layer of the population in order to improve their general management.

Our results were superior to those reported by some African researchers. In-

deed, Amidou *et al.* (2018), Sanon *et al.* (2014) and Ouedraogo *et al.* (2016), in Burkina, in Benin, had found prevalences of 13.9%, 17.3%, and 12.86%, in their study population [19] [21] [23]. Attia (2012) in Cote d'Ivoire, Sagoe (2012) in Ghana also found lower prevalences than ours which were 13.4% and 13% respectively in ARV treatment naive patients [37] [38]. Significantly lower prevalences were also reported, 7.9% and 3.8% [40] [41]. This could be explained, on the one hand, by the selection criteria of the study population. Indeed, our study was on ARV treatment naïve patients; whereas some studies [23] [40] [41], concerned populations composed essentially of patients under treatment. The presence of ARV treatment can lead to a possible HBsAg seroconversion. On the other hand, it is also necessary to take into account the fact that Burkina Faso is part of the high prevalence areas of HBV infection (>8%). In addition, the prevalence of 24.11% of viral hepatitis B in our cohort of HIV infected patients was higher than that of the general population of our country [42]. This could be explained by the similarity of HIV and HBV transmission routes. This is why since 2015 the WHO has advocated for the routine inclusion of Tenofovir in combination therapies for the first-line treatment of HIV infections. Indeed, Tenofovir is effective on both HIV and HBV. In our study, this recommendation had been implemented in all HIV/HBV co-infected (100%) against only 44.44% in the study conducted by Ouedraogo *et al.* (2016) [23]. In this population, 26 and 21 patients achieved Anti HBc Ac and Anti HBs Ac respectively. Among the latter, 8 were positive for Anti HBc (immunized patients) and 1 for Anti HBs (cured patient) that is respectively prevalences of 30.76% and 4.76%. These results are higher than those found by Farid *et al.* (2019) [41] in Belgium who noted prevalences of Anti HBc and HBeAg of 10.5% and 1.3%. This could be explained by the size of the samples tested. Indeed, many prescribers in our context limit themselves to prescribing HBsAg for hepatitis B screening, the other parameters (HBeAg, Anti HBc, Anti HBsAg) being very rarely prescribed. As for the prevalence of hepatitis C, 02 patients out of 78 (2.26%) were positive for HCV antibody. Our results were similar to those found by Ouédraogo *et al.* (2016) [23] in his study on HIV/HBV and HIV/HCV co-infections in Ouagadougou (2.14%). However, this prevalence is significantly lower than that of the general population of Burkina Faso. Koné (2016) [22] in Mali and Forbi *et al.* (2007) [40] in Nigeria noted prevalences of 6.5% and 11.1%. In fact, the rate of hepatitis C serology in our context remains low, which underestimates the prevalences obtained. However, Rockstroh *et al.* (2005) [43] in Europe found in his study on the influence of Hepatitis C on the progression of HIV infection a much higher prevalence (32.9%). This is due to the fact that injecting drug use, which is one of the main routes of HCV transmission, is still a growing phenomenon in Europe. Also, injecting drug users are much more likely to be screened for hepatitis C than the rest of the population. The probability of HIV/HBV co-infection was 0.29% or 29.9%, comparable to 37.18% probability found by Amona, *et al.* (2018) [44] in Congo Brazzaville. The probability of HIV/HCV co-infection and

HIV/HBV/HCV triple co-infection was 0% and 0.93% respectively. On the other hand, these probabilities were higher (2.7% and 0.7%) in the study conducted by Tremeau-Bravard (2013) [45] in Nigeria. These low rates found in our study would be explained by the low prevalence rate of hepatitis C in our study; two (2) patients were positive for hepatitis C; which made it difficult to relate the 03 infections.

In this study, we found weight gain in patients after initiation of ART. One of the goals of ART initiation is to improve the clinical status of patients, including suppression of opportunistic infections and weight gain. In adults, the factors influencing weight gain under ARV treatment include gender, CD4 T-cell count before initiation of treatment and treatment regimen. Furthermore, the number of clinical events decreased during follow-up. In fact, 89.97% of opportunistic infections found in our study were present during the first year of follow-up. These clinical results which are comparable to those of Pitroipa *et al*., (2013) [20] and Sanon *et al.* (2014) [21] reflect a good immune restoration. We observed an improvement of the immune and virological status after the initiation of the treatment with values of CD4 T lymphocytes and CV progressive according to the duration of exposure to the treatment. In fact, one of the objectives of the treatment is the restoration of the immune and virological status of the patients. Moreover, the mean CD4 rate and the mean CV at M12 and M24 found in our study were significantly higher than those found by Pitroipa *et al.* (2013) [20]; Ilboudo, (2013) [36]. This could be explained by the implementation since the end of 2015 of the new recommendations for the management of HIV infected patients. Indeed, the success of treatment depends on early introduction. Numerous studies have shown that early initiation of treatment considerably reduces HIV-related morbidity and mortality as well as transmission of the virus [17] [46]. Thus, the aim of the new recommendations is to move from a therapeutic notion to a preventive one by using treatment as a means of controlling the epidemic at a time when other prevention systems are coming up against certain limitations, notably because sexual attitudes are very difficult to change [46]. On the other hand, 12.14% and 11.08% of patients had immunological and virological failure respectively under treatment. This can be explained by the insufficient follow-up of patients on ART. Indeed, therapeutic success also requires rigorous biological monitoring. However, this is lacking in our context due to insufficient laboratory equipment on the one hand, and on the other hand by the failure of patients to keep follow-up appointments, a phenomenon that has become more pronounced with the advent of COVID 19.

Indeed, many facilities that used to perform viral load tests have been requisitioned for the management of COVID 19 cases. Despite of stringent control measures, COVID-19 continues to circulate worldwide, severely disrupted the health care system and halted socioeconomic activities [47]. Also, a virological success (undetectable viral load) was reported in 91.25% of patients who started treatment after 6 months of follow-up against 82.76% after 12 months. This is

due to the abandonment of health services and treatment by some patients after having noticed some improvement in their health status. Measures should therefore be taken to better equip the testing laboratories and also to sensitize HIV PLWHA on the importance of adhering to their follow-up schedule. In addition, patients with alanine amine transferase levels above normal represented 2.97% of the study population. The mean was 28.58 ± 28.83 IU with extremes of 0 and 355.7. Elevated transaminases could be associated with co-infection with hepatitis viruses, use of traditional drugs or alcohol consumption. The mean creatinine clearance was 97.7 ± 27.98 mL/min; 11.08% of patients had a clearance below normal (90 mL/min). Alterations in renal function are common in HIV-infected subjects; this would be associated with black race, older age, presence of hypertension or diabetes and advanced state of immunosuppression [48] [49]. A large proportion of patients were anemic (40.32%). Other studies report the high frequency of anemia in HIV infected patients. Pitroipa *et al.* (2013) noted a frequency of anemia of 47% [20], ranging up to 85.2% [21]. Generally, anemia is multifactorial in cause and is reported to be related to inflammatory syndrome, immunosuppressed status, viral and bacterial comorbidities, black race and female sex among others [50]. In the study population, patients who started their antiretroviral treatment according to the 2INTI + 1INNTI regimen were statistically higher (p-value < 2.2e−16), *i.e.* a frequency of 73.35%, with a predominance of the TDF-3TC-EFV protocol (45.9%). These results are in perfect correlation with the literature of the last few years [6] [8]. Many countries have in fact adopted the WHO recommendations, which indicate the 2INTI + 1INNTI protocol as the first-line treatment for HIV-1 positive patients. In addition, the TDF-FTC-EFV combination, due to its ease of use and greater availability in our countries, has been indicated as first-line therapy since 2013 by the WHO in the absence of contraindications to one of the molecules. However, the use of this regimen has been declining significantly. Indeed, Maud (2012) in Ouagadougou and Pitroipa *et al.* (2013) in Bobo Dioulasso noted a frequency of use of the 2INTI + 1INNTI protocol of 98% and 98.3% respectively [46] [20]. This regression is attributable to the appearance in 2018 of a new highly effective molecule: Dolutegravir (INI) thus increasing the frequency of use of the 2INTI+ 1INI regimen (TDF-3TC-DTG) which had already been implemented in more than a hundred low- and middle-income countries [8] and which represented 22.96% of the regimens used in our study. Overall mortality in our study population during 5 years of follow-up was 3.6%; lower than Pitroipa *et al.* (2013) (11.8%) and Ilboudo (2013) (9.2%) [20] [36]. This result certainly does not reflect the reality because there is a gap in the notification of deaths. Indeed, the service concerned by this study is not an inpatient unit, many patients die in other health centers. As a result, these patients are generally classified as lost to follow-up. However, the improvement in patient management with the new WHO recommendations could also explain this low mortality rate. Indeed, nationally the number of HIV related deaths has decreased from 3800 in 2015 to 3000 in 2019 [18].

Moreover, the frequency of lost to follow-up in our study was 17.41%. This result is higher than that found by Pitroipa *et al.* (2013) (11.1%) [20] and much higher than that of Ilboudo, (2013) (2.2%) [36]. Among these 17.41%, about 7% were lost to view during the years 2020-2021. This can be explained on the one hand by the failure to notify cases of death in the follow-up service which are attached to the lost to sight but also and especially by the epidemic context in COVID 19. Indeed, as collateral victims of this pandemic, people living with HIV (PLHIV) have suffered from the allocation of resources (human, material and financial), initially intended for their care, to the care of coronavirus patients. It would thus be advisable to establish strategies in order to minimize at most the repercussions of the fight against COVID 19 on the care of the HIV PLWHA at the risk of moving further away from the objectives fixed at the horizon 2030 (95-95-95), in order to end the AIDS epidemic.

5. Conclusion

This study showed that the patients were mostly young, uneducated women. HIV1 was the predominant serotype. The pathologies frequently reported at the first consultation were diarrhoea and herpes zoster, and nearly 43% of the patients had less than 200 CD4/µL, reflecting late screening of the patients and consequently the initiation of late antiretroviral treatment, which could compromise the subsequent prognosis of the infection in these newly treated patients. The clinical and biological evolution was relatively good in the patients after the initiation of treatment. Indeed, weight gain and immune restoration were progressive in the majority. Also, the clinical events decreased during the follow-up; the CD4 gain during the follow-up was regular and the viral load after 06 months of follow-up became undetectable in nearly 92% of the patients. This shows the crucial importance of putting patients who test positive on treatment. HIV-HBV co-infection was 24.11% and HIV-HCV co-infection was 2.26% above the national prevalence in the general population. Thus, we can affirm that hepatitis B and/or C is co-infections that increasingly affect people living with HIV. In addition, the number of people lost to follow-up has increased considerably in recent years due to the advent of COVID 19.

6. Recommendations

The results of this study show that it is undeniable that emphasis should be placed on raising awareness of the culture of early detection among the population in order to prevent contamination and improve progress on ART, but also to develop effective strategies for combating HIV in times of other epidemics and/or pandemics. It would also be appropriate to systematically search for HBV and HCV infection when HIV infection is discovered.

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Author Contributions

Study concept and design: TMZ, IPD, and WWEKS. Sample collection and processing: WWEKS and ES. Statistical analysis and interpretation of data: WWEKS, IPD, TMZ. Drafting of the manuscript: WWEKS, IPD and TMZ. Critical revision of the manuscript for important intellectual content: YEH, LT, DO, WFD, CMN, MB, PO, MS, DSK, YT and JS. Study supervision: TMZ, IPD and JS.

Conflicts of Interest

The authors declare no competing interests.

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