

# Factors Associated with the Unsuppressed Viral Load of Children on Antiretroviral Therapy Followed Up in the Gbêkê Region (Côte d'Ivoire)

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**How to cite this paper:** Hélène, T.-A.A., Christelle, S.-A., Christian, Y.K., Roméo, A.L., Roland, Y.K., Landryse, S., Alexise, A., Alice, T.W.T., Junior, G.K. and Vincent, A.K. (2021) Factors Associated with the Unsuppressed Viral Load of Children on Antiretroviral Therapy Followed Up in the Gbêkê Region (Côte d'Ivoire). *Open Journal of Pediatrics*, 11, 723-737.  
<https://doi.org/10.4236/ojped.2021.114067>

**Received:** October 29, 2021

**Accepted:** December 5, 2021

**Published:** December 8, 2021

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## Abstract

**Introduction:** Unsuppressed viral load (VL) in immunocompromised children on antiretroviral therapy (ART) increases the risk of child morbidity and death. The aim of the study was to identify factors associated with unsuppressed viral load in children on ART for the improvement of prognosis. **Patients and Methods:** this is a retrospective, descriptive and analytical study carried out from July 2015 to December 2019 in the 28 pediatric HIV/AIDS treatment centers supervised by the NGO IRAA in the region of Gbêkê. It included children from 0 to 15 years who were HIV positive, on ART for at least 6 months with at least one viral load. The variables studied were socio-demographic, diagnostic and evolutionary. Data analysis was descriptive and analytical with a significance level of  $p < 0.05$ . **Results:** out of 329 children included, 118 (62 boys, 53 girls) had a non-suppressed VL, *i.e.* a prevalence of 36%. The mean age at diagnosis was 61 months. The mother was a small trader (36.4%), illiterate (45.8%). Unsuppressed viral load was significantly associated with poor nutritional status at the start of treatment ( $p < 0.001$ ), non-compliance with treatment ( $p < 0.001$ ), poor maternal education ( $p = 0.011$ ) and the lack of follow-up of the mother in the context of PMTCT ( $p = 0.03$ ). **Conclusion:** Unsuppressed viral load is common in children on ART in the Gbêkê region. It mainly concerns the child who did not comply with ART, and whose mother was not followed within the framework of PMTCT. Strengthening early detection, early initiation of ART, PMTCT and increased therapeutic education strategies would improve the prognosis of children infected with HIV.

## Keywords

Child, HIV, Unsuppressed Viral Load, Compliance, Associated Factors, Côte d'Ivoire

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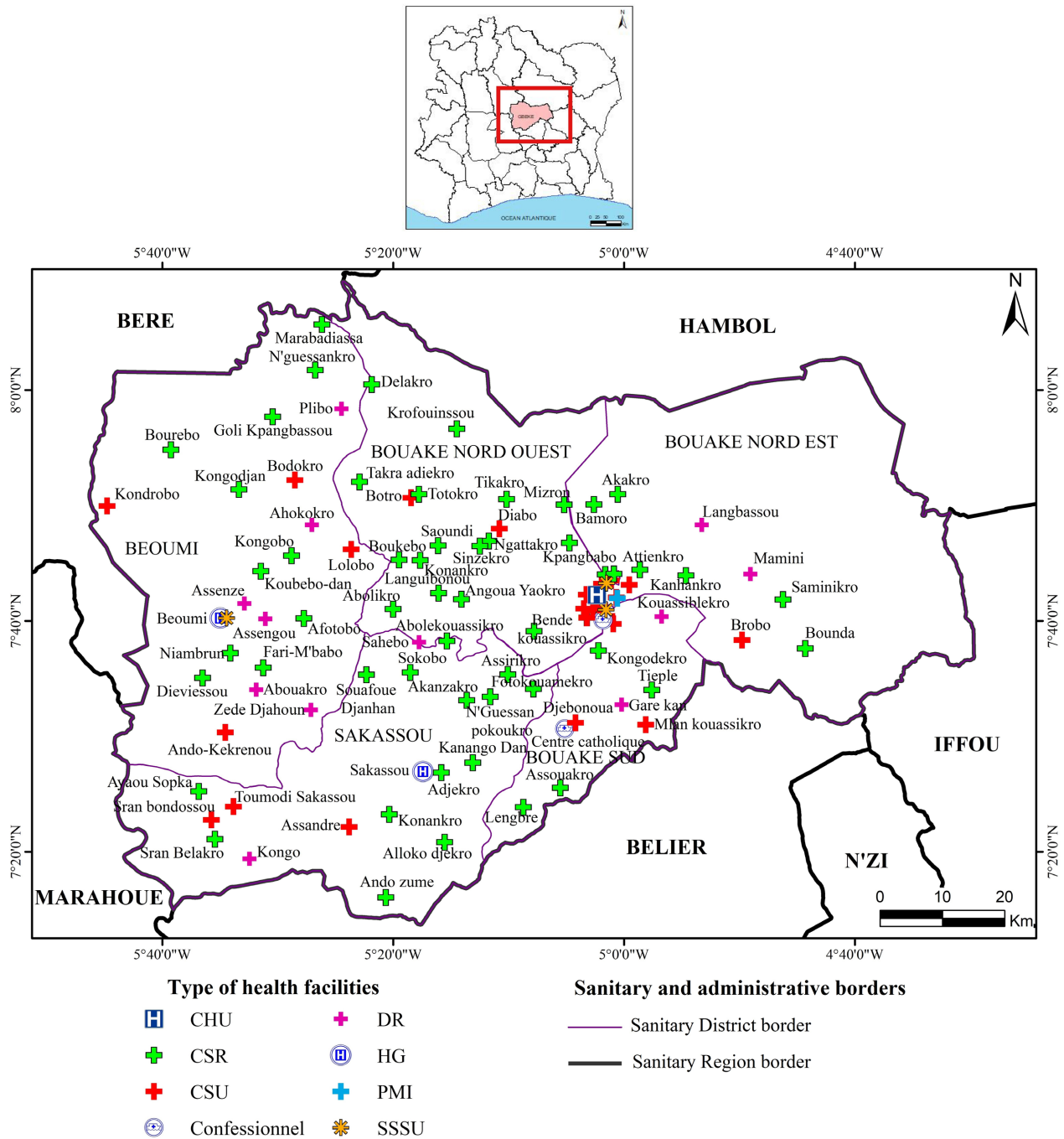
## 1. Introduction

Despite scientific advances and advances in the fight against HIV/AIDS infection over the past decade, HIV/AIDS infection continues to be a major public health problem around the world. In 2020, 38 million people were living with HIV, including 1.8 million children under the age of 15 [1]. For the management of pediatric cases, new classes of antiretrovirals with dosage forms suitable for children have been developed. This allows us to hope for the control of this pandemic. But access to ART is a problem because only 53% of infected children have access to this therapy [1]. For children on ART, viral load monitoring is the recommended approach to verify the effectiveness of treatment and to determine whether viral load suppression is achieved and maintained [2]. According to UNAIDS, in 2019 globally, 59% of people living with HIV had a suppressed viral load [1]. In the study by Cissé *et al.* [3] in Senegal in 2015, 64% of the children in the cohort had treatment failure. This proportion was 17.6% in the study by Penda *et al.* [4]. In Benin, Zohoun *et al.* [5] reported in 2019, a prevalence of treatment failure of 24.4% with as associated factors, poor compliance, the occurrence of comorbidities such as tuberculosis, complex treatment regimens and molecule substitutions more than twice in the same therapeutic line. In the case of Côte d'Ivoire, the prevalence of HIV infection reported in 2018 was 2.6%, or 460,000 people living with HIV. Among its people living with HIV, there were 31,000 children under the age of 15, of whom 12,349 were on ART [6]. For these children on ART, the prevalence of treatment failure is not precisely known nationally. However in the Gbêkê region, Asse *et al.* [7] reported in 2019 in the pediatric department of the University Hospital of Bouaké that 38.3% of children followed in the context of PMTCT had an unsuppressed viral load, but without specifying the significant factors associated with this condition. The aim of the study was to determine the prevalence and factors associated with unsuppressed viral load for the improvement of prognosis in children infected with HIV.

## 2. Methods

This was a retrospective descriptive and analytical study carried out from July 1<sup>st</sup>, 2015 to December 2019 in the Gbêkê health region comprising five health districts: South Bouaké, North-East Bouaké, North-West Bouaké, Béoumi, Sakassou. This health region covered 1410 localities spread over an area of approximately 8996 km<sup>2</sup> (2.79% of the Ivorian national territory). It has 1,082,958 inhabitants [8]. In 2019, the Gbêkê health region included 116 first-contact health fa-

cilities, 02 General Hospitals, 01 University Hospital (Figure 1) [8]. In this Gbêkê health region, pediatric HIV care activities are supported and supervised by the Non-Governmental Organization Institute for Research and Action in Africa (IRAA) in 28 health facilities. The study took place in these 28 pediatric HIV infection management centers. The study population consisted of all children aged 0 to 15 years living with HIV diagnosed on clinical and laboratory



Source: Direction regionale santé Gbêkê, 2018; DPPEIS, 2017

Author : SREU Eric, 2018

Figure 1. Location and presentation of the Gbêkê health region [8].

grounds, treated and followed up at one of the treatment sites. All HIV positive children aged 0 to 15 years, on ARV treatment for at least 6 months and having achieved a viral load in the 6<sup>th</sup> month were included in the study. All HIV positive children aged 0 to 15 years on treatment for less than 6 months, or having more than 6 months of treatment but not having received a viral load measurement were not included until after 12 months of treatment. The sample consisted of all children infected with HIV, registered and followed up in the various HIV AIDS testing and care centers in the Gbêkê regions. These received technical and financial support from IRAA and met the inclusion and non-inclusion criteria. The data was collected over a period of 4 months from January to April 2020. After agreement of the various officials involved in the study, one to three field visits to each site for the care of HIV infection was carried out. Once on the site, the database of all children in care was queried. From this database, all the children meeting the inclusion criteria were selected from the customer code. Data were collected from the individual patient file of the selected children. In the client file, we studied the following variables: 1) the socio-demographic characteristics of the child (sex, age, level of education, place of residence) and of the parents (index, level of education, HIV serology, initiation of antiretroviral treatment, the outcome), 2) the child's HIV parameters at diagnosis (Prevention of Mother-to-Child Transmission in the mother, age at diagnosis, place and date of diagnosis, cotrimoxazole prophylaxis, opportunistic infections, type of HIV, CDC clinical stage, CD4 count, viral load, place of care, date of initiation of treatment and ART regimen, weight and height), 3) evolution at visits of M3, M6, M12 (CD4 count, viral load, compliance education, CDC clinical stage, weight, height, opportunistic infections, cotrimoxazole prophylaxis, compliance and outcome). The study was carried out after obtaining authorization from the General Directorate, the Medical and Scientific Directorate and the Head of the Pediatric Department of the Bouaké University Hospital, the Regional Directorate as well as the Departmental Directorates of the Gbêkê region. Anonymity and confidentiality were respected by assigning an anonymity number to each survey sheet. Data were entered from Epi info 7 computers software. The analysis was descriptive and analytical. To investigate factors associated with unsuppressed viral load, we used the Odd ratio with a 95% confidence interval and a significant p-value < 0.05.

### 3. Results

- **Sociodemographic characteristics of children and mothers**

Out of 329 children under the age of 15 included, 118 had an unsuppressed viral load, ie a prevalence of 36%. The child whose viral load was not suppressed was a boy in 62 cases and a girl in 53 cases, for a sex ratio of 1.2. At the time of diagnosis, the child's age was 60 months or less in 60.7% of cases with an average age of 61 months (extremes 2 and 168 months). The age at the start of treatment was greater than or equal to 60 months in 47.9% OF cases and greater than or equal to 24 months in 66.7% of cases with a mean age of 65.8 months (extremes:

2 and 168 months). The child was out-of-school in 57.6% of cases, and in primary school in 34.8% when he was in school. The mother of the child was illiterate 45.8% of the time. Her activity was small trading in 36.4% of cases. She was HIV positive in 83% of cases and alive in 72%. Concerning the socio-demographic aspects, there was no significant difference between the two groups of children (suppressed viremia and non-suppressed viremia) for sex, age at diagnosis, age at initiation of treatment, mother's education, mother's occupation, mother's serology and mother's outcome (**Table 1**). However, a significant difference between the two groups was noted for the educational level of the child ( $p < 0.001$ ) and place of residence ( $p = 0.02$ ) (**Table 1**).

- **Diagnostic characteristics**

The mother was followed up for PMTCT in 15% of cases. In children with unsuppressed viremia, serotype HIV 1 was found in 100% of cases at diagnosis. At the clinical level, the child was in Stage A of the CDC classification or asymptomatic in 60.2% of cases. He had a CD4 count  $> 500$  in 60% of cases, with an average of  $679 \pm 487$  CD4 (extremes: 1 and 1834 CD4). The child was in good nutritional status in 24.6% (**Table 2**). The main pathologies associated with HIV infection in children with unsuppressed viremia were malnutrition (55.7%), tuberculosis (11.5%), pneumonia (6.55%) and rhinobronchitis (6.55%) (**Table 2**). For the diagnostic aspects, there was no significant difference between the two groups of children concerning the CD4 count at the initiation of the treatment. A statistical difference was observed for the nutritional status of the child ( $p < 0.001$ ), the mother's follow up for PMTCT ( $< 0.001$ ) and for the associated pathologies ( $p = 0.001$ ) (**Table 2**).

- **Therapeutic and evolutionary characteristics**

The main treatment regimens prescribed combined two nucleoside reverse transcriptase inhibitors (NRTIs) and a non-nucleoside reverse transcriptase inhibitor (NNRTI) in 71.7% of cases and two nucleoside reverse transcriptase inhibitors (NRTIs) and an inhibitor of protease (PI) boosted in 26.5% of cases (**Table 3**). ART compliance was achieved in 55.7% of cases. Cotrimoxazole prophylaxis was initiated in 69% of cases. The main reasons for non-compliance identified were forgetting (30%), non-compliance with prescriptions (25%) and treatment interruption (15%). The child was still in the active queue (94.8%; 112/118), transferred to another care center (2.5%; 3/118), lost to follow-up (1.7%; 2/118) and deceased (0.9%; 1/118). With regard to treatment characteristics, there was no statistically significant difference between the two groups of children in terms of cotrimoxazole treatment. A statistical difference was observed for treatment regimen ( $p = 0.018$ ) and adherence to antiretroviral treatment ( $p < 0.0001$ ) (**Table 3**).

**Factors associated with unsuppressed viraemia**

Factors associated with unsuppressed viral load were maternal education level ( $p = 0.01$ ; odds ratio = 2.2), PMTCT follow-up ( $p = 0.03$ ), Nutritional status at the start of treatment ( $p < 0.001$ ), and compliance to ART ( $p < 0.001$ ; odds ratio = 9.8) (**Table 4**).

**Table 1.** Sociodemographic characteristics of children living with HIV with viremia suppressed versus viremia not suppressed and their mothers.

Variables	unsuppressed viremia		suppressed viremia		p Value
	Frequencies (n/N)	Percentage	Frequencies (n/N)	Percentage	
<b>Sex</b>					
• Boy	62/118	52	95/211	45	0.31
• Girl	53/118	45	112/211	53	
• Unspecified	3/118	3	4/211	2	
<b>Age at diagnosis (month)</b>					
• [0 - 24]	43/118	36.8	48/211	22.7	0.07
• [24 - 60]	28/118	23.9	63/211	29.8	
• [60 - 120]	31/118	26.5	69/211	32.7	
• [120- 180]	15/118	12.8	28/211	13.3	
<b>Age at start of treatment (month)</b>					
• [0 - 60]	61/118	52.1	91/211	43.1	0.22
• [60 - 180]	56/118	47.9	111/211	52.6	
<b>Child education level</b>					
• Out-of-school	68/118	57.6	57/211	27.1	<0.001
• Primary	41/118	34.8	98/211	46.4	
• Secondary	4/118	3.4	7/211	3.3	
• Unspecified	5/118	4.2	49/211	23.2	
<b>Residency</b>					
• Bouaké	70/118	59	125/211	59.2	0.02
• Out of Bouaké	29/118	25	30/211	14.2	
• Unspecified	19/118	16	56/211	26.5	
<b>Mother's level of education</b>					
• Illetrate	54/118	45.8	75/211	35.5	0.06
• Primary	8/118	6.8	33/211	15.6	
• Secondary	12/118	10.1	23/211	10.9	
• Higher education	0/118	0	4/211	2	
• Unspecified	44/118	37.3	76/211	36	
<b>Mother activity</b>					
• Small trader	43/118	36.4	69/211	33	0.25
• Housewife	37/118	31.4	76/211	36	
• Grower	2/118	1.7	0/211	0	
• Others**	3/118	2.5	4/211	2	

**Continued****Mother serology**

• HIV 1 Positive	98/118	83	162/211	77	0.25
• Negative	2/118	15	2/211	1	
• Unknown	18/118	2	47/211	22	

**Mother's outcome**

• Alive	85/118	72	137/211	65	0.42
• Dead	24/118	20	55/211	26	
• Unknown	9/118	8	19/211	9	

\*Child living with HIV; \*\*Caregiver (1), teacher (1), warden (1).

**Table 2.** Diagnostic characteristics of HALE\* without suppressed viraemia.

Variables	unsuppressed viremia		suppressed viremia		pValue
	Frequencies (n/N)	Percentage	Frequencies (n/N)	Percentage	
<b>Mother's follow up for PMTCT**</b>					
• Yes	18/118	15	15/211	7	<0.001
• No	100/118	85	178/211	84	
• Unknown			18/211	9	
<b>CDC clinical stage***</b>					
• A	53/118	44.9	-	-	
• B	20/118	16.9	-	-	
• C	11/118	9.3	-	-	
• N	18/118	15.3	-	-	
• Unspecified	16/118	13.6	-	-	
<b>Nutritional status</b>					
• Good	29/118	24.6	26/211	12.3	<0.001
• Severe acute malnutrition	22/118	18.6	106/211	50.2	
• Moderate acute malnutrition	12/118	10.2	20/211	9.5	
• Non-determined	55/118	46.6	59/211	28	
<b>CD4 count at the start of treatment</b>					
• ≤200	6/40	15	21/74	28.4	0.5
• ]200; 350]	6/40	15	8/74	10.8	
• ]350; 500]	4/40	10	4/74	5.4	
• >500	24/40	60	41/74	55.4	
<b>Associated pathologies</b>					
• Malnutrition	34/61	55.7	126/157	80.2	0.001
• Tuberculosis	7/61	11.5	11/157	7	

**Continued**

• Pneumonia	4/61	6.55	4/157	2.5
• Rhinobronchitis	4/61	6.55	3/157	1.9
• Anemia	3/61	4.9	0/157	0
• Oral candidiasis	2/61	3.3	2/157	11.3
• Others****	7/61	11.5	11/157	7

\*Child living with HIV; \*\*Prevention of mother-to-child transmission of HIV; \*\*\*Centers for disease control and prevention; \*\*\*\*Herpes zoster (1), Viral hepatitis B (1), angina (1), dermatosis (1), poly lymphadenopathy (1), purulent otorrhea (1), acute gastroenteritis (1).

**Table 3.** Therapeutic characteristics of HIV/AIDS with non-suppressed viraemia.

Variables	unsuppressed viremia		suppressed viremia		p Value
	Frequencies (n/N)	Percentage	Frequencies (n/N)	Percentage	
<b>Therapeutic regimen*</b>					
• ABC-3TC-EFV	46/118	39	121/211	57.3	0.018
• ABC-3TC-LPV/r	30/118	25.4	36/211	17.1	
• AZT-3TC-NVP	15/118	12.7	11/211	5.2	
• TDF-3TC-EFV	11/118	9.3	22/211	10.4	
• AZT-3TC-EFV	5/118	4.2	10/211	4.7	
• ABC-3TC-NVP	4/118	3.4	5/211	2.3	
• ABC-3TC-AZT	2/118	1.7	1/211	0.5	
• ABC-3TC-TDF			1/211	0.5	
• AZT-3TC-LPV			2/211	1	
• Not mentioned	5/118	4.2	2/211	1	
<b>Cotrimoxazole</b>					
• Start	69/118	58.5	123/211	58.3	0.34
• Ongoing	9/118	7.6	18/211	8.5	
• No	22/118	18.6	26/211	12.3	
• Not mentioned	18/118	15.3	44/211	20.9	
<b>Compliance to ART**</b>					
• Yes	64/118	43	185/211	87.7	<0.0001
• No	51/118	54	16/211	7.6	
• Not mentioned	3/118	3	10/211	4.7	
<b>Reason for non-compliance</b>					
• Oversight	6/118	5.1	-	-	
• Non-compliance with prescriptions	5/118	4.2	-	-	



**Continued**

• Interruption of treatment	3/118	2.5	-	-
• Skipping medication	3/118	2.5	-	-
• Bad adherence	2/118	1.7	-	-
• Negligence	1/118	0.9	-	-
• Not mentioned	98/118	83.1	-	-

\*ABC = abacavir; 3TC = lamivudine; EFV = efavirenz; NVP = nevirapine; TDF = tenofovir; AZT = zidovudine; LPV/r = lopinavir boosted with ritonavir; \*\*antiretroviral therapy.

**Table 4.** Factors associated with unsuppressed viral load in children living with HIV receiving antiretroviral therapy in the Gbêkê region.

Variables	Viral load		Odds ratio [IC95%]	p Value
	Suppressed	Unsuppressed		
<b>Nutritional status</b>				
Good	26	29	0.24 [0.13 - 0.46]	<0.001
Malnutrition	126	34		
<b>Compliance</b>				
Yes	185	64	9.2 [5.17 - 18.68]	<0.001
No	16	51		
<b>Mother education level</b>				
Schooled	60	20	2.2 [1.19 - 4.06]	0.011
Unschooling	75	55		
<b>PMTCT*</b>				
Yes	15	18	0.46 [0.22 - 0.93]	0.03
No	178	100		

\*Prevention of mother-to-child transmission of HIV.

## 4. Discussion

This retrospective descriptive and analytical work carried out in 28 centers for the management of HIV infection in children in the Gbêkê region aims to research the factors associated with unsuppressed viral load of children aged 0 to 15 years old living with HIV and on antiretroviral therapy. The study shows that the prevalence of unsuppressed viral load is high in children on antiretroviral therapy in the Gbêkê region and is accompanied by various pathologies. The factors associated with this unsuppressed viral load are nutritional, therapeutic and maternal. However, the results must be qualified. Indeed, the study only concerned children whose follow-up was evaluated after just one year of treatment, and who had achieved a viral load during this first year of treatment. In addition, regular updates of national guidelines for the care of PLWHIV could constitute a selection bias. The retrospective nature of the study with its corol-

lary of missing information constitutes a bias that could underestimate or overestimate the results of the study. Despite the methodological limitation, the results of the study raise the following points of discussion in terms of prevalence, socio-demographic, diagnostic, therapeutic and evolutionary characteristics.

- **Concerning the prevalence and socio-demographic characteristics of the mother-child couple**

The prevalence of unsuppressed viral load in children receiving antiretroviral therapy in the Gbêkê region is high (36%). Asse *et al.* [7] in 2019 in Bouaké (Ivory Coast) reported a prevalence of 38.3%. Cissé *et al.* [3] in Senegal in 2015 and Penda *et al.* [4] in 2013 in Cameroon respectively found a prevalence of 64% and 17.6%. This variability could be explained on the one hand by methodological differences and on the other hand by the care guidelines for PLWHIV varying from one country to another. However, all these studies have the merit of demonstrating that the absence of viral suppression in the management of HIV/AIDS constitutes a major public health problem in sub-Saharan Africa. In this work, the child living with HIV (HIV/AIDS) with unsuppressed viremia is in the majority of cases male (sex ratio = 1.2). This result is comparable to that found by Haile *et al.* [9] in 2019 in Ethiopia with a sex ratio of 1.32. On the other hand, other authors have reported a predominance of women. Indeed, Almeida *et al.* [10] in 2013 in Benin and Mossoro-Kpinde *et al.* [11] in 2017 in the Central African Republic reported a sex ratio of 0.9 and 0.86 respectively. Asse *et al.* [7] in 2019 in Bouaké (Ivory Coast) did not report a difference in sex. In 60.7% of cases, the children are under 5 years old at the time of diagnosis. This late diagnosis of HIV infection in children points to an inadequate strategy to prevent mother-to-child transmission of HIV (PMTCT). This hinders the early initiation of ART and certainly explains why in the study the initiation of ART in children was carried out in 66.7% of cases beyond the age of 24 months, with an average age of 65,8 months. In the PMTCT unit of the pediatric department of the Bouaké University Hospital, Asse *et al.* [7] reported in 2019, mean age of 57.9 months at the start of ART. Oumar *et al.* [12] in Ségou, Mali in 2016, also reported late initiation of antiretroviral therapy with a mean age at initiation of treatment of 5 years.

The initiation of treatment at a late age in children living with HIV increases the risk of developing opportunistic diseases in children which are functional and life-threatening. WHO therefore recommends stepping up strategies for the detection and early treatment of children infected with HIV [13]. In the present study, approximately 2 out of 3 children lived in urban areas. This could be explained by the decentralization of care for PLWHIV in the region of Gbêkê and by a high concentration of pediatric HIV infection care centers (19/28) were in the only town of Bouake. With regard to the mothers of these children, it emerges from this work that 45.8% of the mothers are illiterate. This low level of education could explain the high proportion of housewives (31.4%) and small traders (36.4%) in the study. In Asse *et al.*'s study in 2019 [7], the proportion of

housewives represented 71.3%. Dainguy *et al.* [14] reported 11.1% of uneducated mothers at Cocody University Hospital in Abidjan in 2014. This finding thus raises the problem of women's schooling with the low socio-economic level as a corollary. According to UNESCO, the literacy rate for women does not exceed 50% in more than 12 countries in sub-Saharan Africa [15]. The low level of maternal education is a factor associated with the unsuppressed viral load in children living with HIV ( $p = 0.011$ ) in the study. The low level of education of the mother represents, in terms of health vulnerability, danger and constitutes an obstacle to the implementation of PMTCT as well as to the achievement of good compliance to treatment [9].

- **At the diagnostic level**

The study found that 85% of mothers did not receive PMTCT follow-up. This result is similar to that of Cissé *et al.* [3] who had found 70% of mothers did not followed-up within the framework of PMTCT. Haile *et al.* [9] made the same observation with 93.4% of mothers. The insufficient follow-up of mothers within the framework of PMTCT negatively impacts that of their child. This observation is made in the study by Asse *et al.* [7] which reported 90.5% of children not having received antiretroviral prophylaxis for PMTCT. Kouakou *et al.* [16] found a loss of follow-up at 12 months of 100% in the setting of PMTCT. This low rate of PMTCT achievement is a factor associated with unsuppressed viral load ( $p = 0.03$ ). It could be explained by the non-respect of the appointments by the mothers, the refusal of the follow-up by the parents, the fear of stigmatization and the denial of the disease in our African socio-cultural context. The HIV 1 serotype is found in all children with non-suppressed viremia. Almeida *et al.* [10] in Benin in 2013 reported 100% of HIV 1 cases. Asse *et al.* [7] in 2019 at the Bouaké University Hospital had found HIV 1 in 92.8% and HIV 2 in 7.2% of cases. The same observation was made by Cisse *et al.* [3] in Senegal in 2015 with HIV 1 in 96.7% and HIV 2 in 2.2% of cases. The high proportion of HIV 1 in these studies could be explained by the fact that among the 3 types of HIV, HIV 1 is the most common serotype in sub-Saharan Africa [17]. In the study, the child was in good nutritional status in about a quarter of cases and was malnourished in 28.8%. This is severe malnutrition in 18.6% and moderate in 10.2% of cases. For Cissé *et al.* [3] in Senegal in 2015, children had good nutritional status in 59% and were malnourished in 27% of cases. In 2011, Jesson *et al.* [18] reported that 42% of HIV-positive children suffered from malnutrition in West and Central Africa. A higher frequency (60.2%) was found by Mwadianvita *et al.* [19] in 2014 in Congo. These results confirm the close link between malnutrition and HIV/AIDS infection. Malnutrition is a factor of poor prognosis in children living with HIV. It worsens the disease, increases morbidity and decreases the chances of survival of the immunocompromised child. Thus in this work, poor nutritional status is identified as a factor associated with unsuppressed viral load ( $p < 0.001$ ). Malnutrition (55.7%), tuberculosis (11.5%), pneumonia (6.55%) and nasopharyngitis (6.55%) are the main pathologies encountered in children infected with HIV with unsuppressed viremia. Dicko *et al.* [20] in Mali in 2013

and Diarrassouba *et al.* [21] in Côte d'Ivoire in 2010 found the same associated pathologies but in different proportions. This high proportion of associated pathologies is the consequence of immunosuppression due to the drop in the TCD4 lymphocyte level, which is inversely proportional to the viral load. This exposes the child to all kinds of pathologies and opportunistic infections. In the study, 44.9% of children are at stage A and 9.3% at stage C of the CDC classification. These results are different from those of Asse *et al.* [7] in 2019 in Bouaké in Côte d'Ivoire, which found 46% of children at stage C. Ouedraogo *et al.* [22] in Burkina Faso in 2015 found 43.5% of children at stage III and IV of the WHO classification. This difference could be explained by a methodological bias, in fact, this work is multicentric, while the studies by Asse *et al.* [7] and Ouedraogo *et al.* [22] were monocentric and hospital-based, which may justify the large proportion of children with advanced disease. In the study, 60% of the children had a CD4 count  $> 500$  cells/mm<sup>3</sup>. This result is similar to that of Haile *et al.* [9] in Ethiopia 2019 who found 75.8% of children with a CD4 count  $> 500$  cells/mm<sup>3</sup>.

- **At the therapeutic and evolutionary level**

In the study all the children with high viremia were on triple therapy; it is the combination of 2NRTI + 1NNRTI in 68.6%, 2NRTI + boosted PI in 25.4% and 3NRTI in 1.7% of cases. Asse *et al.* [7] in Bouaké in 2019 reported therapeutic regimens combining 2NRTI + 1NNRTI in 90.5%, 3NRTI in 5.9% and 2NRTI + boosted PI in 3.6% of cases. These treatment protocols comply with the various national guidelines for the management of HIV/AIDS. Still, on the therapeutic level, the study shows that cotrimoxazole prophylaxis is initiated at the start of treatment in 69% of cases and in 22% of cases is not performed. This low rate of initiation of Cotrimoxazole at the start of treatment could be explained by the clinical and/or biological status of certain patients, which contraindicates its initiation. In addition, some patients may have experienced side effects from the drug, leading the health worker to stop this prophylaxis. The study found that only 54% of children adhere to ART. The same observation was made by Penda *et al.* [4] in 2013 in Cameroon, which reported 41% compliance among children with treatment failure. The low rate of children observed in this work could be explained by the non-compliance with the times of intake or the dosages by the parents. In addition, the side effects of ARTs could act as an obstacle on good compliance. Another cause for poor compliance is denial of the disease by parents or by the child for fear of stigma. This poor compliance results in the development of resistance to ARTs and non-suppression of viral load during the course of this treatment. In fact, in this work, poor compliance is a factor associated with unsuppressed viral ( $p < 0.001$ ). The child with unsuppressed viremia is still in the active queue in 94.8% of cases, lost to follow-up in 1.7% and died in 0.9% of cases. This high rate of retention of children in care and the low rate of loss of follow-up and death reflect on the one hand the effectiveness of the strategies put in place by all the actors involved in the fight against HIV/AIDS, and on the other hand, the effectiveness of ART.

## 5. Conclusion

Non-suppression of viral load in HIV-positive children is common in the Gbêké region. It most often concerns the boy in whom the diagnosis and initiation of ART were late. The mother of this child is mostly illiterate and has not been followed for PMTCT. This non-suppression viral load is accompanied by various pathologies affecting the prognosis of the child. The factors associated with this unsuppressed viremia are poor nutritional status at the start of treatment, poor compliance to treatment, low level of mother's education and lack of maternal follow-up for PMTCT. Thus, the fight against illiteracy and poverty, reinforcement of screening, early initiation of ART, PMTCT strategy, active search for those lost to follow-up and accentuation of therapeutic education strategies would make it possible to improve the prognosis of children infected with HIV.

## Authors' Contributions

All authors contributed intellectually to the preparation and revision of the manuscript prior to its submission.

## Acknowledgements

NGO IRAA, Health Regional Directorate of Gbêké, Responsible for all health centers involved in pediatric HIV care in the region of Gbêké.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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