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Original Article

Assessment of Viral Load Suppression in HIV-Infected Children in Brazzaville (Congo)

Évaluation de la Suppression de la Charge Virale chez les Enfants Infectés par le VIH à Brazzaville (Congo)

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ABSTRACT

Introduction. HIV is a major global health issue for children. This study assessed viral suppression rates in HIV-infected children in Congo, focusing on the impact of gender, age, and ART duration. **Methods**. This retrospective study analyzed viral load samples from 75 children (ages 1-17) at Brazzaville University Hospital between January and June 2024. Data included HIV status, age, sex, ART start, and viral load. Viral suppression was defined as <1000 RNA copies/mL. Samples were processed with the Xpert HIV-1 Viral Load platform, and statistical analysis (Fisher's exact test, 5% cut-off) compared viral load by age, sex, and ART duration. **Results**. Among 75 children, 78.7% (59/75) achieved viral load suppression. Girls had a slightly higher suppression rate (78.8%) than boys (78.6%). Suppression was 100% in children aged 5-9 years, and 79% in those aged 1-4 and 10-14 years, with the lowest rate (72.4%) in those aged 15-17. Children on ART for >2 years had higher suppression rates (75%-100%) compared to those on ART for <2 years (64.7%). Fisher's exact test showed a significant difference between ART durations (p = 0.0071), but no significant differences by age group (p = 0.2332) or sex (p = 1). **Conclusion.** This study found that 78.7% of HIV-infected children in Congo achieved viral load suppression. Antiretroviral therapy duration was key for suppression, while gender and age had no significant impact.

RÉSUMÉ

Introduction. Le VIH est un problème de santé majeur pour les enfants. Cette étude a évalué les taux de suppression virale chez les enfants infectés par le VIH au Congo, en se concentrant sur l'impact du sexe, de l'âge et de la durée de l'ART. **Méthodes.** Cette étude rétrospective a analysé les échantillons de charge virale de 75 enfants (âgés de 1 à 17 ans) à l'Hôpital universitaire de Brazzaville entre janvier et juin 2024. Les données comprenaient le statut VIH, l'âge, le sexe, le début de l'ART et la charge virale, la suppression étant définie par <1000 copies ARN/mL. Les échantillons ont été traités avec la plateforme Xpert HIV-1 Viral Load, et une analyse statistique (test exact de Fisher, seuil de 5%) a comparé la charge virale selon l'âge, le sexe et la durée de l'ART**. Résultats.** Parmi les 75 enfants, 78,7 % (59/75) ont obtenu une suppression de la charge virale. Les filles ont montré un taux de suppression légèrement plus élevé (78,8 %) que les garçons (78,6 %). La suppression était de 100 % chez les enfants de 5 à 9 ans, et de 79 % chez ceux de 1 à 4 ans et de 10 à 14 ans, avec le taux le plus bas (72,4 %) chez les enfants de 15 à 17 ans. Les enfants sous ART depuis plus de 2 ans ont montré des taux de suppression plus élevés (75 % à 100 %) par rapport à ceux sous ART depuis moins de 2 ans (64,7 %). Le test exact de Fisher a montré une différence significative selon la durée de l'ART (p = 0,0071), mais aucune différence significative selon le groupe d'âge (p = 0,2332) ou le sexe (p = 1). **Conclusion.** Cette étude a montré que 78,7 % des enfants infectés par le VIH au Congo ont atteint une suppression virale. La durée du traitement anti rétrovirale a été un facteur clé de suppression, tandis que le sexe et l'âge n'ont pas eu d'impact significatif.

INTRODUCTION

HIV, or human immunodeficiency virus, is a retrovirus that attacks the body's immune system. The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS). HIV targets white blood cells, especially CD4 cells, weakening the immune system and making those affected more susceptible to various opportunistic diseases such as tuberculosis, infections and certain cancers (1). HIV remains a major global public health problem (1). In 2023, an estimated 39.9 million people were living with HIV worldwide, including 5.1 million in West and Central Africa (2).

HIV type 1 (HIV-1) can be transmitted vertically from mother to child before delivery, during labor and delivery, or postpartum via breastfeeding (3, 4). The vulnerability of children to HIV/AIDS is a critical aspect of the pandemic that deserves special attention. Approximately 48,000 new HIV cases were in children aged 0–15 years, 35% of whom were on antiretroviral therapy (ART) (2). The impact of the HIV epidemic on young children is serious and far-reaching. HIV-infected children suffer from a variety of physical health problems, such as vulnerability to infection and malnutrition, as well as mental health problems, including stress, anxiety and depression. They also face school interruptions and significant social stigma, leading to isolation and discrimination (5).

As momentum in efforts to control the pandemic intensifies, the global commitment to end the HIV/AIDS epidemic has been set by the United Nations General Assembly for 2030 (6). Reducing the incidence and providing antiretroviral treatment to those infected are key to making progress and achieving this goal. Since 2013, World Health Organization (WHO) guidelines have recommended viral load (VL) testing as the preferred surveillance approach for all people treated with ART, to assess response to treatment, detect treatment failure, and determine the need for a rapid transition to a second-line regimen (7). More recently, the 2016 WHO guidelines identify HIV-infected infants and children as a priority group for preferential and routine VC surveillance (8, 9). The 2024 report of the Joint United Nations Programme on HIV/AIDS (UNAIDS) indicates that globally, 86% of people living with HIV knew their status, 89% had access to treatment, and of these, 93% had viral suppression. For children aged 0 to 14 years, 66% knew their status, 86% had access to treatment, and 84% were virally suppressed (2).

Studies in some African countries have reported varying dropout rates among children, for example in Mozambique (44%) (10), Malawi (57.9%) (11), Ethiopia (71.7%) (12), Rwanda (68.8%) (13) and Cameroon (79.4%) (14). In Congo, Dokekias et al. reported a viral suppression rate of 70.8% in adolescents and adults in 2008 (15). However, despite HIV prevention efforts, regular viral load assessment remains essential to monitor the effectiveness of antiretroviral therapy in HIV-infected infants and young children. This assessment makes it possible to quickly detect cases of resistance to treatment and to adjust treatment protocols accordingly.

Our study focused on assessing viral suppression rates in HIV-infected children in Congo, analyzing the impact of three main factors: gender, age, and duration of ART. By better understanding these factors, it is possible to develop more effective strategies to improve viral suppression rates in children and ensure a better quality of life for this vulnerable population.

MATERIALS AND METHODS

Study design and population

This was a retrospective cross-sectional study using secondary data from viral load samples collected from children aged 1 to 17 years. These children had undergone HIV viral load tests at the bacteriology-virology laboratory of the University Hospital of Brazzaville (Congo) from January 1 to June 30, 2024.

A total of 75 patient records were included in this study. The HIV status of these patients was known and their records included complete information on the date of sample collection, age, sex, ART start date and viral load result. The data was extracted from the database and cleaned. Viral suppression was defined as a viral load of less than 1000 copies of RNA per milliliter of blood plasma. Viral non-suppression corresponded to a viral load equal to or greater than 1000 RNA copies per milliliter.

Sampling

Sampling was systematic among all children who underwent HIV-1 RNA quantification during the period of this study. A total of 111 cases of children under 18 years of age were analyzed, from which 75 files presenting variables of interest for our study were retained.

Sample collection and viral load quantification

For viral load determination, blood samples collected from tubes containing an anticoagulant (EDTA) were collected and an aliquot of plasma from each sample was prepared and stored at −80◦ C (as a precautionary measure if additional testing was required) for a minimum of one day and a maximum of 3 months. Aliquots were used for viral load determination with GeneXpert.

HIV-1 RNA quantification was performed on plasma samples using the 16-module Xpert HIV-1 Viral Load platform (Cepheid, Sunnyvale, CA), according to the manufacturer's instructions. One milliliter of plasma was transferred to the Xpert cartridge and loaded into the GeneXpert (one module, four samples per analysis). RNA extraction, purification, reverse transcription and real-time quantification of cDNA were performed in the fully automated system. The dynamic range was between 1.60 and 7.0 log(10) copies/mL for this amount of plasma. HIV RNA values below the limit of detection (<40 copies/mL) were considered to be at the lower limit of detection (40 copies/mL) for the test used.

Statistical analysis

Data entry and analysis were done on Microsoft Office Excel 2019 software. The Fisher exact test was used for the comparison of viral load with age, sex, and duration of ART. The significance threshold was 5%.

RESULTS

Basic characteristics of study participants

A total of 75 children aged 1 to 17 years were included in this study. The average age of this population was 11 years. The most represented age group was 15 to 17 years old (38.7%), followed by 1 to 4 years old (25.3%) and 10 to 14 years old (25.3%), then 5 to 9 years old (10.7%). Male subjects were in the majority, representing 56% of the population studied (Table 1). Approximately 22.7% (17/75) of participants had been on antiretroviral therapy for approximately 0 to 2 years.

Table I : Characteristics of Study Participants (N = 75)

Characteristics	N	%
Age (years)		
1- 4	19	25,3
5-9	8	10,7
10-14	19	25,3
15-17	29	38,7
Sex		
Masculine	42	56
Feminine	33	44

Of these children, approximately 78.7% (59/75) had a suppressed viral load. Viral load suppression was slightly higher in girls (78.8% - 26/33) than in boys (78.6% - 33/42). By analysing the distribution of the population by age group, it was observed that the viral load suppression was total (100%) in children aged 5 to 9 years. The 1 to 4 years, 10 to 14 years, and 15 to 17 years had viral load suppression rates of 79%, 79%, and 72.4%, respectively. Children on antiretroviral therapy for more than two years had the highest rates of viral load suppression, ranging from 75% to 100%. In contrast, the lowest viral load suppression rate (64.7%) was recorded in children whose treatment duration did not exceed two years.

To assess the impact of gender, age, and duration of ART on viral load suppression in children, we used the Fisher exact test with a significance level of 5%. The results of our analysis showed a statistically significant difference between viral load suppression rates for children with ART duration ≤ 2 years and those with ART duration > 2 years ($p = 0.0071$). In contrast, there was no statistically significant difference between viral load suppression rates for the 1-9 year and 10-17 year age groups ($p = 0.2332$), nor between viral load suppression rates for male and female children ($p = 1$).

Characteristics of the study population and viral suppression

Table II: Characteristics of the study population and viral load suppression

Characteristics	Total	Viral burden			P value
		<1000 copies/ml (%)	>1000 copies/ml (%)	Suppression rate	
Overall	75	59	16	78,7%	
Sex					1,000*
Masculine	42	33 (55,9)	9 (56,3)	78,6%	
Feminine	33	26 (44,1)	7 (43,7)	78,8%	
Age (years)					0,2332*
1-4	19	15 (25,4)	4 (25)	79%	
5-9	8	8 (13,6)	0 (0)	100%	
10-14	19	15 (25,4)	4 (25)	79%	
15-17	29	21 (35,6)	8 (50)	72,4	
Duration of Anti Retroviral Treatment (years)					0,0071**
0-2	17	11 (18,6)	6 (37,5)	64,7%	
3-5	12	9 (15,3)	3 (18,8)	75%	
6-10	11	11 (18,6)	0 ()	100%	
11-14	17	13 (22)	4 (25)	76,5	
15-20	18	15 (25,4)	3 (18,8)	83,3%	

* Difference not significant; ** Significant difference; <1000 copies/mL: Viral load suppressed but detectable; >1000 copies/ml: high viral load

DISCUSSION

This study explores viral load suppression rates in HIV-infected children in Congo, providing crucial insight into the effectiveness of antiretroviral treatments in this paediatric population. The results obtained, although indicative of certain trends, require additional studies with larger samples to validate and deepen these observations.

This study, which involved 75 children aged 1 to 17 years on antiretroviral therapy (ART), found that 78.7% (59/75) of participants had a suppressed viral load (< 1,000 copies/ml). This demonstrates an encouraging overall effectiveness of antiretroviral treatment in this population.

The overall suppression rate observed in our study was higher than that recorded by Fataha et al. in Mozambique (44%) in children aged 0 to 14 years on ART (1), as well as that reported by Fatti et al. in South Africa (66%) in children and adolescents aged 0 to 15 years on ART (2). This difference in viral load suppression rates could be related to the fact that our study included children over 16 years of age, who might have adhered better to their antiretroviral treatment regimen, but also to differences in study design.

Our results show that viral load suppression is slightly higher in girls (78.8% - 26/33) than in boys (78.6% -

33/42). This observation is consistent with the findings of Fataha et al., who also found that men were more likely not to achieve viral suppression than women (1). What's more, a 2014-2015 study in Kenya of children aged 0-15 years also showed that being a boy was associated with lower viral load suppression (3). This finding suggests that boys may have more difficulty adhering strictly to the antiretroviral regimen, possibly due to differences in social roles and expectations that may influence adherence to treatment from an early age. In contrast, a study of adults, adolescents and children receiving antiretroviral therapy in Cameroon showed that men achieved viral suppression of 80.9%, while women had a rate of 75.9% (14). Although this study indicates a relatively greater suppression of viral load in men than in women, it is crucial to note that other studies have frequently reported that men are more likely to experience virologic failure than women. These discrepancies in the results can be attributed to contextual and cultural variations between the different regions studied. Risk-related behavioral patterns, such as alcohol and drug use, play a significant role in viral load suppression. Lower acceptance of health services among men may also contribute to these disparate outcomes.

Our results showed that viral load suppression was complete (100%) in children aged 5 to 9 years, while viral load suppression rates for the 1 to 4 years, 10 to 14 years, and 15 to 17 age groups were 79%, respectively. 79%, and 72.4%. These findings indicate a high efficacy of ART in young children, particularly those aged 5 to 9 years, which could be attributed to improved adherence to treatment and increased parental support. In parallel, another study conducted by Diress et al. in Ethiopia (2016-2019) on adults and children found a trend that as age increases, the chances of viral load suppression also increase (6). This study showed that the likelihood of viral load suppression increased with age, partly corroborating our observations. Older children and adolescents may develop a better understanding of the importance of their treatment and its impact on their health, which improves their adherence to treatment.

In our study, we found that children who had been on ART for more than two years had the highest rates of viral load suppression (75% to 100%), while children who had been on ART for less than two years had the lowest rate of viral load suppression (64.7%). In contrast, a study conducted by Nasuuna et al. in Uganda showed that, among children receiving intensive counselling on ART adherence, longer duration of ART was associated with increased viral load suppression in children up to 14 years of age (7). Both studies highlight the importance of ART duration and adherence to treatment in achieving viral load suppression, but highlight different aspects. First, adherence to treatment plays a crucial role. Children who have been on ART for more than two years in our study may have better adherence to treatment, while the Uganda study highlights the importance of intensive counselling to improve adherence. Second, community and educational supports, as well as the complexity of the treatment regimen, can influence outcomes. Finally, regional and socio-economic differences may also play a role.

The analysis of the results obtained allows us to identify several interesting points concerning the impact of gender, age and duration of ART on viral suppression in children. First, the results show a statistically significant difference between viral load suppression rates for children with ART duration ≤ 2 years and those with ART duration > 2 years ($p = 0.0071$). This indicates that the duration of antiretroviral therapy plays a crucial role in achieving viral load suppression. Children who had been on ART for more than two years showed higher rates of viral load suppression, suggesting that continuity and regularity of treatment are key factors for treatment success. These findings are consistent with previous studies that highlight the importance of long-term adherence to ART for optimal outcomes (1, 4, 6).

In contrast, no statistically significant difference was observed between viral suppression rates for the 1-9 year and 10-17 year age groups ($p = 0.2332$). This lack of significant difference may be explained by a relative homogeneity of adherence and response to treatment in these age groups. Although variations in viral load suppression rates were observed between different age groups, they are not large enough to be statistically significant. This may indicate that other factors, such as family and community support, play a more prominent role in the success of antiretroviral therapy in children.

In addition, no statistically significant differences were observed between viral load suppression rates for male and female children ($p = 1$). This lack of difference suggests that gender does not have a significant impact on viral load suppression in this pediatric population. These findings contrast with some previous studies that have reported differences in viral load suppression between the sexes, but also confirm other research that has not found such differences (1, 4, 6). It is possible that contextual, cultural and behavioural variations specific to each region influence these results.

Limitations of the Study

Our study has several limitations. First, the small sample size (75 children) limits statistical power and the ability to detect significant differences. In addition, the sample may not be representative of the entire HIV-infected paediatric population in Congo, thus influencing the generalisation of the results. Differences in treatment protocols and quality of care can also influence outcomes. Finally, the specific regional and socio-economic context in Congo may limit the applicability of the findings to other regions.

CONCLUSION

This study highlights encouraging rates of viral load suppression among HIV-infected children in Congo, with 78.7% of participants having a suppressed viral load. The results demonstrate a significant effectiveness of antiretroviral therapy (ART) in this pediatric population. However, the analysis found that the duration of ART is a crucial factor, with children on ART for more than two years showing significantly higher rates of suppression. No statistically significant differences were observed between viral suppression rates by sex and age group.

These results highlight the need for further research with larger samples to better understand the dynamics of viral load suppression and optimize therapeutic strategies. The limitations of this study, including small sample size and contextual variability, should be considered when interpreting the results. Despite these limitations, this study contributes to the knowledge of the effectiveness of ART in children and offers prospects for improving future therapeutic interventions.

DECLARATIONS

Conflict of interests

The authors declare no conflict of interest

Financing

The work was carried out with own funds

Ethical considerations

All stages of the work were carried out in compliance with the Declaration of Helsinki.

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