Factors Associated with Poor Viral Suppression Among Children and Adolescents Accessing Antiretroviral Therapy in Selected Health Facilities in Lagos, Nigeria

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Abstract

Introduction

Nigeria has the second largest HIV burden in Sub-Saharan Africa, with high burden amongst children and adolescents. In 2017, it was estimated that 160,000 children (0-9 years) and 230,000 adolescents (10-19 years) are living with HIV globally, with death in 21,000 children and 5400 adolescents resulting from AIDS-related illnesses. The main objective of the study was to determine the factors associated with poor viral suppression in children and adolescents accessing antiretroviral therapy in secondary health facilities in Lagos State.

Methods

A descriptive retrospective study of children and adolescents living with HIV accessing care and support in 7 Global Fund supported ART treatment facilities in Lagos between January 2013 and June 2020. Data extraction was done between July 2020 and August 2020. The sociodemographic, clinical and laboratory data were extracted from patients' folders. Binary logistic regression model was done to identify the determinants of viral non-suppression among children and adolescents age groups.

Results

The study population consisted of 363 children (age 0-9 years) and 275 adolescents (age 10-19 years). The mean age of children was 5.8±2.2 years and that of adolescent was 13.21±2.8years.

About 256(70 %) of children were virally unsuppressed and 118(43 %) had non-suppressed viral load status among adolescents. Binary logistic regression showed that children with WHO stage IV of HIV disease had greater odds (OR=7.984, 95% CI=1.042-61.163) of having suppressed viral load and children who live with their non-biological caregiver had greater odds of having a suppressed viral load compared to the biological caregiver group (OR=2.0421, 95% CI=1.083-10.965). Among adolescents, binary logistic regression showed location of abode and drug pick-up pattern as independent predictors of poor viral suppression. Adolescent patients living in rural setting had greater odds of being virally unsuppressed compared to those living in urban settlement (OR=1.755, 95% CI=1.001-3.083) while patients who have regular drug pick-up pattern from their ART health centres had lesser odds (OR=0.585, 95% CI=0.591-0.912) of viral non-suppression.

CONCLUSION

The findings highlight the need for a renewed focus on developing and strengthening HIV programmes in rural areas where children and adolescents living with HIV are more likely to be virally unsuppressed. More emphasis and resources should be channelled to Public health intervention such as health education, social support group programmes to improve drug pick up and adherence in adolescents living with HIV.

Introduction

Human Immunodeficiency Virus (HIV) is one of the leading causes of morbidity and mortality due to infectious diseases globally, with the highest impact felt in sub-Saharan Africa [1].

In Sub-Saharan Africa, Nigeria has the second largest HIV burden. The recently concluded national AIDS indicator and impact survey puts the national prevalence at 1.4%, with a prevalence of 0.2% in children aged 0–14 years. Globally, the annual number of new infections among children (0–14 years) has almost halved since 2010 with a 47% reduction in new HIV cases, despite this significant progress, the number of children becoming newly infected with HIV remains unacceptably high, [2], [3], [4]

While accurate health-related data for children and adolescents remain scarce and are not readily available in Nigeria [5] there is emerging evidence indicating that this age groups have been facing challenges in accessing focused HIV services [6]. Due to the peculiar challenges of both age groups, which include various socio-economic barriers and a tendency towards high-risk sexual behaviours among adolescents, it is important that children and adolescents achieve protracted viral suppression during lifelong ART to mitigate the exceptionally high mortality associated with unsuccessful HIV treatment, and to achieve the epidemiological goal of HIV control [7] [8]

The President's Emergency Plan for AIDS Relief (PEPFAR) program in Nigeria defines Virologic suppression as a viral load (measured in RNA copies) of less than 1000copies/ml and is the most effective measure of treatment response for patients on ART [9].

Several studies have demonstrated suboptimal viral suppression in children and adolescents in high and low-resource settings. A study conducted in Nigeria, observed that the viral load suppression rates through adolescence and post-transition were only 55.6–64.0% [10]. Another study in Cambodia showed a relatively low viral suppression rate amongst adolescents compared to the adult population groups, with the viral suppression rate at 76.8% and 90% respectively [11]. In Kenya, children were more likely to be virally unsuppressed if their caregivers were not suppressed in comparison to children with caregivers that were virally suppressed [12]. Other associated factors with child viral non-suppression in children as stated in the study include younger child age at ART initiation and child tuberculosis treatment at the time of the viral load assay [13]

Treatment for children and adolescents also presents several challenges including the complexity in ART dosing and the need to adjust doses as the child grows, which may be a problem especially for providers who are not skilled enough with children care or too busy to track the suppression status, which is not an uncommon scenario in low-resource settings where the paucity of healthcare workers is very significant [14].The associated factors of poor viral suppression in these patient group have not been well explored in secondary health care setting in Nigeria and it is important to elicit them with a view to utilizing the findings to mitigate this. This study was conducted to identify factors associated with poor viral suppression among children and adolescents accessing antiretroviral therapy.

Methods And Materials

Study design and population

This is a descriptive retrospective study of children and adolescents living with HIV accessing care and support in The Global Fund supported ART treatment facilities in Lagos from January 2013 to June 2020. The

study was conducted in seven secondary health facilities supported by the Lagos State Ministry of Health and The Global Fund. The study population consisted of 638 patients, this represent all the active children and adolescent in care at the time period [363 children (0-9 years) and 275 adolescents (10-19 years)]. Data collection was done between July 2020 and August 2020.

Eligibility Criteria

A. Inclusion

The inclusion criteria is all HIV positive children (0-9years) and adolescents (10-19 years) who are currently on ART for at least 6 months and have had at least one viral load result at the time of the study.

B. Exclusion

The exclusion criteria is all HIV positive children (0-9 years) and adolescents (10-19 years) who currently have treatment interruption or loss to follow up and have not had at least one viral load result. Patients who were transferred out of the study facilities and those who were reported dead during the period were also excluded from the study.

Data collection

The study population consisted of 638 patients (363 children and 275 adolescents). The health facilities under study do not have an electronic medical record (EMR), therefore data were manually extracted from patient folders. A Microsoft Excel template was designed to extract patient-level data, containing participant's specific index. The information extracted includes age at time of ART initiation, WHO clinical staging at diagnosis, current ART regimen, drug pick-up pattern (2 years prior till date), weight at baseline and at every 6 months interval until current weight, most recent viral load result, socio-demographic characteristics, and the disclosure status of the child.

Patient unique identifiers were excluded from the dataset to ensure anonymity and preserve patient confidentiality. Excel sheets used in the abstraction of study data were encrypted during transmission in line with standardized data safety protocols.

In this study, a *regular drug pickup pattern* is defined as consistent drug pick-up on the scheduled dates as shown on the care card while an *irregular drug pickup pattern* is a drug pick up pattern that is not consistent with the scheduled dates and without proof of extra pills that accounted for the inconsistent pickup dates. Drug pickup pattern is used as a proxy measurement for adherence, this is because it is considered an objective measure for adherence. *Full disclosure* is defined in this study as patients (children and adolescents-10 years and above) who are aware of their HIV status and know they are taking medications because they have HIV while those with *partial disclosure* were patients who are not aware of their HIV status but understands that they need to be on medication to be healthy and those with *no disclosure* are patients who

are not aware of their HIV status and do not know why they are on medication. The support group register was used to abstract data on disclosure. Good adherence in the study is defined as patients with no missed drug pickup appointments while patients with poor adherence are patients with missed drug appointments greater than two weeks from the original drug pickup date.

Outcome variable which is viral load suppression is defined as a viral load (measured in RNA copies) of less than 1000copies/ml.

Data analysis

Statistical analysis was done using SPSS version 23. Initial analyses were done by generating frequency tables and graphs. Appropriate bivariate analysis was carried out to assess statistical associations depending on the type of the variables and a binary logistic regression model was performed to identify factors determining viral non-suppression among children and adolescents age groups. The level of statistical significance was set at p value < 0.05. The adjusted odds ratio and 95% confidence interval were obtained to determine factors associated with viral suppression.

Study limitations

Patients' information was extracted manually and could have resulted in the unintentional omission of patients from the study. Furthermore, the method of data entry could have also resulted in transcription errors.

Results

(a) Socio-demographics of respondents: A total of 638 patients were analysed [363 children (aged 0-9 years) and 275 adolescents (aged 10-19 years)]. Among the respondents, 53.3% (340) were females while 46.7% (298) were males. 206 (56.7%) of children were between 5-9 years with a mean age of 5.8±2.2 years, while majority of the adolescents were between the ages of 10-13 years with a mean age of 13.1±2.8years. About one third of the adolescent patients 90(32.7%) lives in a rural settlement while 106(29.9%) of children lived in rural settlements.

Table 1: Sociodemographic of adolescents and children

Age	Adolescent (n=275)	Children (n=363)	Total (n=638) (%)
0-4 years		157	157(24.6)
5-9 years		206	206(32.3)
10-13 years	135		135(21.2)
14-16 years	77		77(12.1)
17-19 years	63		63(9.8)
Total	275	363	638(100)
Gender			
Female	156	184	340(53.3)
Male	119	179	298(46.7)
Total	275	363	638(100)
Location of abode			
Urban	185	257	442(69.3)
Rural	90	106	196(30.7)
Total	275	363	638(100)

(b) Caregivers of respondents: As shown in figure 1, the predominant caregiver in both age groups were their biological parents, with 92.8% of children and 69.1% of the adolescent patients being cared for by their biological parents.

(c). HIV clinical stage of the respondents at time of diagnosis. Majority of the patients were in WHO Stage 1 classification of the HIV disease, 229(63.1%) in children and 215(78.2%) in adolescents.

(d) The commonest ART regimen used in children and adolescent was AZT/3TC/NVP, 235(64.7%) and 170(61.8%) respectively.

Table 2: ART Regimen used by respondents

ART Regimen in adolescent patients (n=275))	Number (%)
Zidovudine/Lamivudine/Nevirapine	170(61.8)
Tenofovir/Lamivudine/Efavirenz	67(24.4)
Tenofovir/Lamivudine/Dolutegravir	25(9.1)
Zidovudine/Lamivudine/Efavirenz	7(2.5)
Abacavir/Lamivudine/Efavirenz	5(1.8)
Tenofovir/Lamivudine/Atazanavir/Ritonavir	1(0.4)
ART Regimen in Children (n=363)	**Number (%)**
Zidovudine/Lamivudine/Nevirapine	235(64.7)
Abacavir/Lamivudine/Lopinavir/Ritonavir	73(20.1)
Zidovudine/Lamivudine/Lopinavir/Ritonavir	31(8.5)
Abacavir/Lamivudine/Efavirenz	10(2.8)
Zidovudine/Lamivudine/Efavirenz	10(2.8)
Tenofovir/Lamivudine/Efavirenz	4(1.1)

307 (48.1%) of the patients had being on ART for a duration of less than 2 years, while 331 (51.9%) of the study participants had been on ART for more than 2 years.

An irregular drug pick-up pattern was seen in both groups as almost two thirds 172(62.5%) of adolescents had irregular drug pickup history while almost three quarter 259 (71.3%) of children also had an irregular drug pick-up pattern.

Amongst children who had a documented viral load result, 107(30%) of children living with HIV were virally suppressed while 256(70 %) were virally unsuppressed. For adolescent patients, 157 (57 %) were virally suppressed, and 118(43 %) were documented to be unsuppressed.

As shown in the pie chart, amongst adolescents living with HIV, almost half 135(49.1%) have full disclosure of their HIV status while about one tenth 27(9.8%) do not have their HIV status disclosed to them. 41% of the adolescents were only partially disclosed to, with carers informing them of a chronic disease needing treatment without explicitly telling the children that they were HIV infected.

Table 3: Association between Viral Load and Sociodemographic Variables in Children

Gender	Viral Load		Total (%age)	Chi-square	P-value
	Suppressed	Non-suppressed			
Male	50(27.9)	129(72.1)	179(100.0)		
Female	57(31.0)	127(69.0)	184(100.0)	0.405	0.525
Primary caregiver					
Non-biological Caregiver	12(46.2)	14(53.8)	26(100.0)		
Biological caregiver	95(28.2)	242(71.8)	337(100.0)	3.747	0.049
Current Age					
0-4.9years	43(27.4)	114(72.6)	157(43.3)		
5-9 years	64(31)	142(69)	206(56.7)	0.58	0.446
WHO staging					
Stage I	73(31.9)	156(68.1)	229(100.0		
Stage II	28(27.2)	75(72.8)	103(100.0)		
Stage III	3(12.0)	22(88.)	25(100.0)	5.784	0.041
Stage IV	3(50.0)	3(50.)	6(100.0)		
ART Regimen					
AZT/3TC/NVP	71(30.2)	164(69.8)	235(100.0)		
ABC/3TC/LPV/R	20(27.4)	53(72.6)	73(100.0)		
AZT/3TC/LPV/R	8(25.8)	23(74.2)	31(100.0)		
ABC/3TC/EFV	3((30.0)	7(70.0)	10(100.0)	4.835	0.436
AZT/3TC/EFV	2(20.0)	8(80.0)	10(100.0)		
TDF/3TC/EFV	3(75.0)	1(25.0)	4(100.0)		
Drug pick-up pattern					
Irregular	80(30.9)	179(69.1%)	259(100.0)		
Regular	27(26.0)	77(74.0%)	104(100.0)	0.866	0.352

With whom they live (biological caregiver or non- biological caregiver) and WHO staging of the disease at diagnosis were found to be statistically significant among all other variables at p-value <0.05 as shown in table 3.

Table 4: Factors associated with viral suppression among children

Variables	Odds Ratio	95% CI of OR	P-value
Primary caregiver			
Biological Caregiver	1		
Non-biological Caregiver	2.0421		
WHO Staging			
Stage I	1		
Stage II	2.251	0.429-11.798	0.337
Stage III	2.948	0.540-16.092	0.212
Stage IV	7.984	1.042-61.163	0.046

Binary logistic regression highlighted that patients with WHO stage IV of HIV disease had greater odds (OR=7.984, 95% CI=1.042-61.163) of having suppressed viral load and children who live with their non-biological caregiver had greater odds of having a suppressed viral load compared to the biological caregiver group (OR=2.00.421, 95% CI=0.1.083-10.965). All other variables were found not to be independently associated with non-suppressed viral load.

Table 5: Association of Viral Load and Sociodemographic Variables in Adolescents

Variable	Viral Load		Total	X2	P-value
	Suppressed (n=157)	Non-suppressed (n=118)			
Gender					
Female	88(56.4)	68(43.6)	156(100.0)	0.068	0.794
Male	69(58.0)	50(42.0)	119(100.0)		
Primary care giver					
Biological caregiver	114(60.0)	76(40.0)	190(100.0)	2.124	0.145
Non-biological Caregiver	43(50.6)	42(49.4)	85(100.0)		
Age(Current)					
10-14years	128(59.5)	87(40.5)	215(100.0)		
15- 19years	29(48.3)	31(51.7)	60(100.0)		
WHO Staging					
Stage I	104(59.8)	70(40.2)	174(100.0)		
Stage II	43(51.2)	41(48.8)	84(100.0)		
Stage III	10(58.8)	7(41.2%)	17(100.0)		
ART Regimen					
Tenofovir/Lamivudine/Efavirenz	28(41.8)	39(58.2%)	67(100.0)		
Zidovudine/Lamivudine/Nevirapine	103(60.6)	67(39.4%)	170(100.0)		
Abacavir/Lamivudine/Efavirenz	3(60.0)	2(40.0%)	5(100.0)		
Tenofovir/Lamivudine/Dolutegravir	19(76.0)	6(24.0%)	25(100.0)		
Zidovudine/Lamivudine/Efavirenz	4(57.1)	3(42.9%)	7(100.0)		
Tenofovir/Lamivudine/Atazanavir/Ritonavir	0(0.0)	1(100%)	1(100.0)		
Drug PickUp					
Regular	69(50.0)	69(50.0)	138(100.0)		
Irregular	88(64.2)	49(35.8)	137(100.0)		
Disclosure Status					
Full Disclosure	18(66.7)	9(33.3%)	27(100.0)	5.020	0.041

Partial disclosure			113(100.0)		
	71(62.8)	42(37.2%)			
Non-disclosure	68(50.4)	67(49.6%)	135(100.0)		
Location of Abode					
Urban	117(63.2)		185(100.0)	9.777	0.002
Rural	40(44.4)	50(55.6)	90(100.0)		

Drug adherence among adolescents (adjudged by a regular drug pick-up pattern) was significantly associated with viral suppression (p=0.034). Disclosure status (0.024) and location of abode of patients (p=0.002) were also significantly associated with viral suppression amongst adolescent patients while patients who were non-adherent and live in rural settings were more likely to have poor viral suppression. Poor viral suppression among adolescents was not associated with age, gender, caregiver and WHO staging in this study.

Table 6: Factors associated with viral suppression among adolescents

Variables	Odds Ratio	95% CI	P-value
Age(Current)			
10-14years	1		
15- 19years	1.032	0.864-2.013	0.32
Primary caregiver			
Parent	1		
Guardian	1.447	0.846 - 2.472	0.177
ART Regimen			
Zidovudine/Lamivudine/Nevirapine	1		
Abacavir/Lamivudine/Efavirenz	0.798	0.225-2.811	0.723
Tenofovir/Lamivudine/Efavirenz	1.714	0.947-3.100	0.075
Tenofovir/Lamivudine/Dolutegravir	0.428	0.135-1.363	0.151
Drug Pick-Up			
Irregular	1		
Regular	0.585	0.591-0.912	0.042
Disclosure Status			
Full disclosure	1		
Partial disclosure	1.097	0.439 - 2.737	0.843
Non-disclosure	1.817	0.731– 4.516	0.199
Adherence			
Non-adherence	1		0.142
Adherence	0.678	0.403-1.139	
Location			
Urban	1		
Rural	1.756	1.001-3.038	0.049

Binary logistic regression shows location of abode and drug pick-up pattern as independent predictor of poor viral suppression. Patients living in rural setting have greater odds of having poor viral suppression compared to those living in urban settlement (OR=1.755, 95% CI=1.001-3.083) while patients who have regular drug pick-up pattern from the ART health centre had lesser odds (OR=0.585, 95% CI=0.591-0.912) of viral non-suppression.

Discussion

Viral suppression amongst children living with HIV on treatment has continued to be a challenge across most HIV programs in several countries, with suboptimal viral suppression rates across the population group especially when compared to the adult population groups. A variety of factors have been identified from earlier studies to be responsible for viral non-suppression in children and adolescent patients living with HIV. The commonly identified factors are pharmacological and non-pharmacological, with the latter category comprising sociocultural factors and psychosocial factors.

Findings from this study identified that 30% of children and 57% of adolescents were virally suppressed. The suppression rates are well below program achievements for viral suppression in adults (≈ 90% – 94%), and the set target of 95% for viral suppression according to the UNAIDS framework for HIV program target milestones.

A study conducted in Uganda highlighted a poor viral suppression in children and adolescents living with HIV that ranged between 27% – 29%. Issues identified to be associated with viral non-suppression were fear of disclosure and sub-optimal disclosure of adolescents' HIV status, exhausting medications while traveling, lack of support, feelings of loneliness, lack of perceived improvement while on medication, poor linkage to care, attrition from care and treatment, poor transition from adolescent to adult services, economic hardship and AIDS-related stigma. [15], [16], [17], [18], [19], [20].

In this study, the factors that have a positive association with viral suppression in children are those who live with their biological caregiver / parents and those who commenced ART not later than when they are at WHO clinical stage IV. For adolescents living with HIV on ART, the study revealed a positive association between good adherence, proper disclosure of HIV status and an urban residence. Patients who reside with their biological caregivers are more likely to be virally suppressed than HIV-infected children who lived with non-biological caregivers in children, but this did not appear to be so with the adolescent age group.

A biological caregiver may have a stronger emotional connection with the child and may be more motivated to promote good adherence compared with a non-biologic caregiver. Caregivers who are also on ART may draw from their own experiences to support their child's adherence. While this may be an important factor to their adherence to medication and viral suppression rate in children because of their dependence on their caregiver for administration of their medications, most adolescents living with (ALHIV) do not depend on their caregivers for the administration of their medications, and this might have provided explanation for the difference in the association between viral suppression and caregiver among ALHIV compared to the children group in our study[21] ,[22]

It is important to note that there are conflicting evidence on the impact of caregivers' biological relationship to a child. While some studies agree that there are positive effects to the adherence to medications (adjudged in this study by drug pickup pattern) and viral suppression, other studies pointed otherwise. An Italian study found that younger children living with non-biologic caregivers had better adherence. Similar findings were seen in a US study; however, the association did not maintain significance when controlling for other factors. Conversely, a Romanian study of horizontally infected adolescents found that non-biologic caregivers were associated with worse adherence [23], [24], [25].This might reflect the impact of sociocultural backgrounds and household settings on children psychology and subsequently, drug adherence.

In this study, the WHO clinical staging of HIV disease at baseline was found to be significant in children but not significant in adolescents in affecting the attainment of viral suppression. Children with WHO clinical stage IV disease at baseline assessment were found to be about 8 times more likely to be virally unsuppressed. This finding contradicts the result from a study conducted in Pretoria, South Africa, where it was found that there was no relationship between the WHO HIV clinical staging of patients and their viral load suppression [26]. However this finding is similar with the result of the adolescent group. The limitations in the assessment of genotypic and phenotypic drug susceptibility studies prior to ART commencement might affect the efficacy of ART in children and adolescents, especially those presenting with late-stage disease as there is the possibility of drug resistant viral strains being responsible for the primary HIV infection in the children.

The process of disclosure is an important factor in ensuring adherence to medication and subsequently a reduction in the viral load of the client, therefore efforts to increase the availability and accessibility of treatment should be accompanied by disclosure initiatives. Disclosure is the first step for children transitioning into adolescents and young adults who successfully manage their own HIV care. [27]

The ideal disclosure age in this study was 10 years and above, and this supports a study conducted in Northern and southern Ghana where their preferred age was 10 years [28] .This study also revealed that most of the ALHIV either had partial disclosure or no disclosure of their HIV status, as only one tenth of the patients had being fully disclosed to. The disclosure status was found to be significantly associated with suppressed viral load which is similar with a study in Zambia where disclosure was found to have a strong association with undetectable viral load [29]. This is not unusual as the understanding of a disease state tends to help the patient have insight into why treatment is necessary, especially for chronic illnesses as in this case, HIV infection. Disclosure and awareness of the disease state also invariably tends to affect drug adherence.

Pertaining to the findings of associations between type of living settlements (Rural vs Urban) and viral suppression in PLHIV, patients on ART living in rural areas experience substantial barriers to HIV care, including transportation and long distances to care, provider discrimination and stigma, concerns about confidentiality, lack of health care coverage, and limited healthcare options [30]. These barriers may contribute to delays in HIV testing among PLHIV living in rural areas and some evidence suggests that these categories of patients are less likely to be retained in care, adhere to antiretroviral medication, and reach viral suppression than patients living outside of rural areas. The former are also more likely to delay HIV testing and receive an HIV diagnosis at later disease stages than their non-rural counterparts. [31], [32], [33], [34], [35], [36]

ART regimen are usually standardised according to national treatment guidelines and protocols. Optimised regimens and dosing are especially necessary in children, based on the need to achieve a rapid and sustained viral suppression and good clinical outcomes because of the tendency for a rapid and fulminant progression of HIV disease in this age group.

Conclusion

The identification of the factors that are most positively associated with poor viral suppression in children and adolescent patients living with HIV highlights the need for a renewed focus on developing and strengthening HIV programmes in rural areas where children and adolescents living with HIV are more likely to be virally

unsuppressed. In addition, health education, psychosocial and sociocultural policies which focus on adherence challenges associated with this age groups should be incorporated into HIV programmes.

Declarations

Ethical considerations

Ethical approval was obtained from APIN Institutional Review Board, a registered IRB under the National Health Research Ethics Committee. The study approval number is #IRB040-FR. In addition, patient unique identifiers were excluded from the dataset to ensure anonymity and preserve patient confidentiality. Excel sheets used in the abstraction of study data were encrypted during transmission in line with standardized data safety protocols.

Availability of data and material

Data and material are available on request

Consent for Publication

Not applicable

Authors' contributions

The authors are involved in the conception and design of the work, data collection, data analysis and interpretation, drafting the article, while the corresponding author was involved in the critical revision of the article and all the authors approved the final version to be published

Competing interest

We declare that there are no competing interest

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Figures

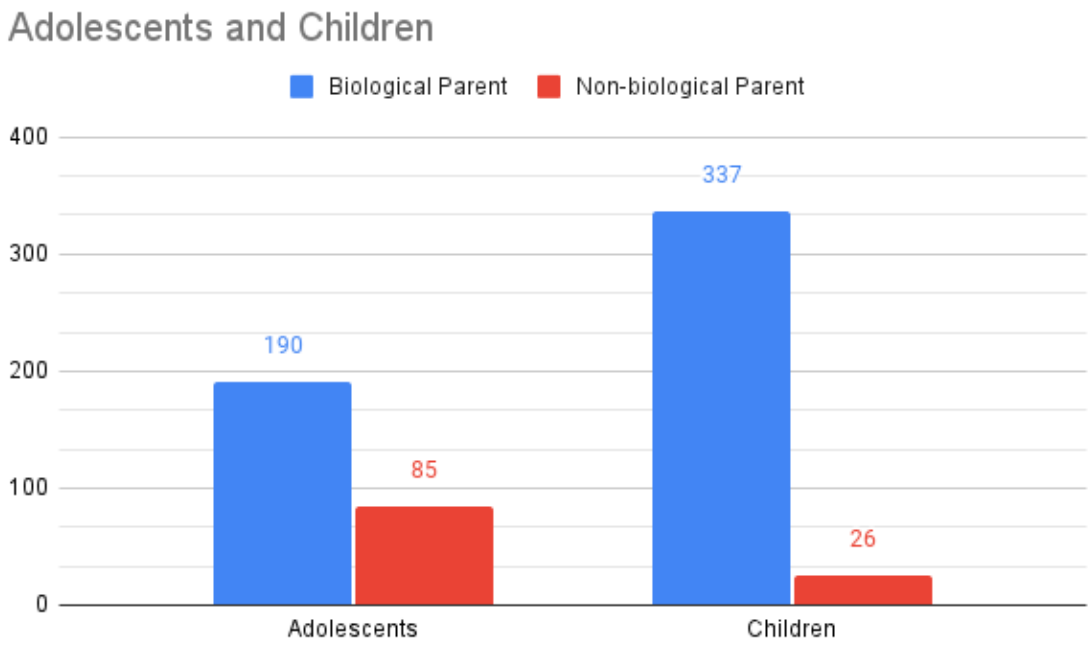

Figure 1

chart showing the primary caregivers for the adolescent and children cohorts.

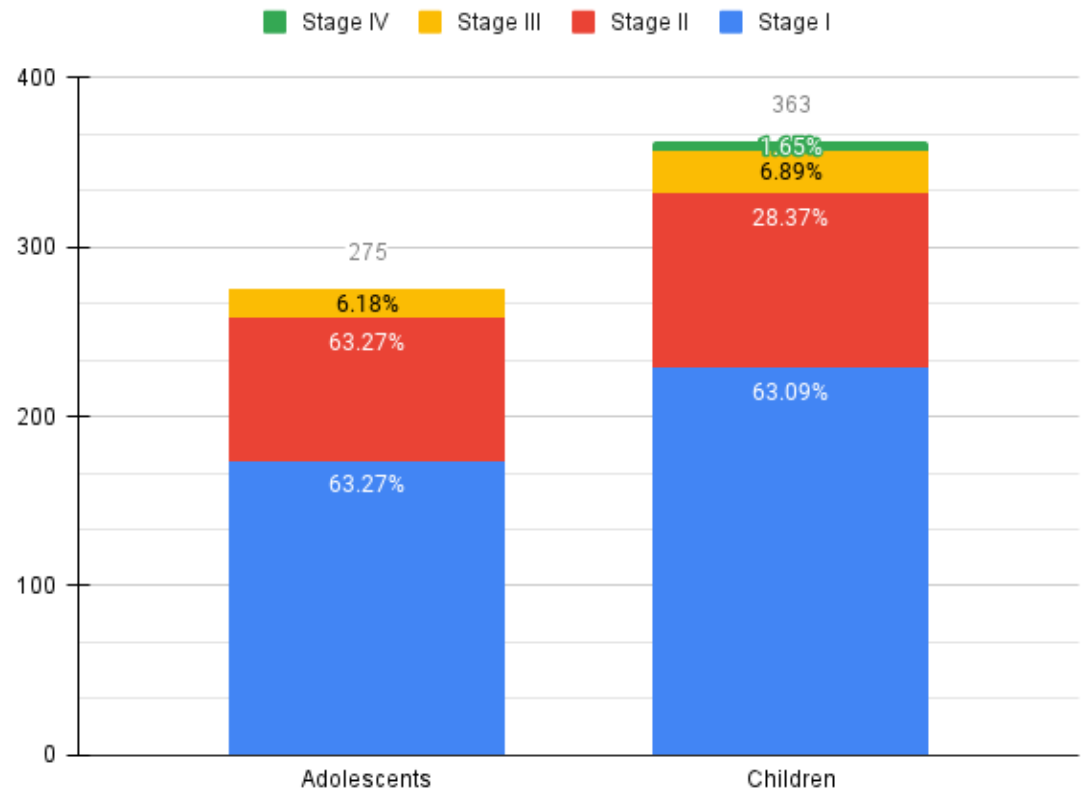

Figure 2

The different WHO clinical staging of adolescents and children at the point of entering in ART management

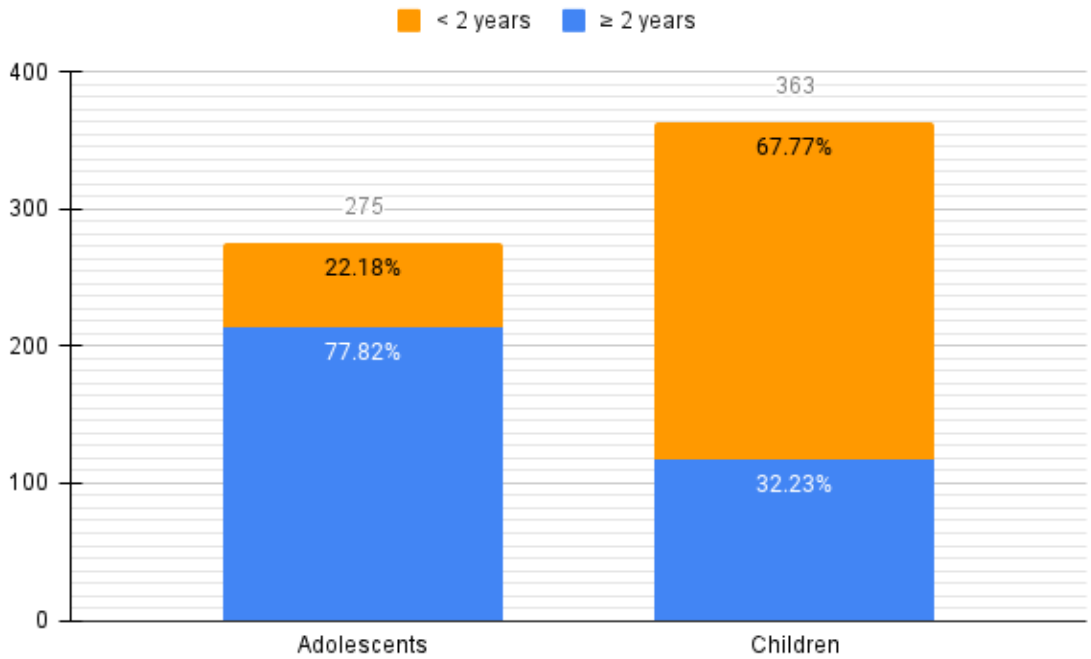

Figure 3

Duration on ART therapy for adolescents and children

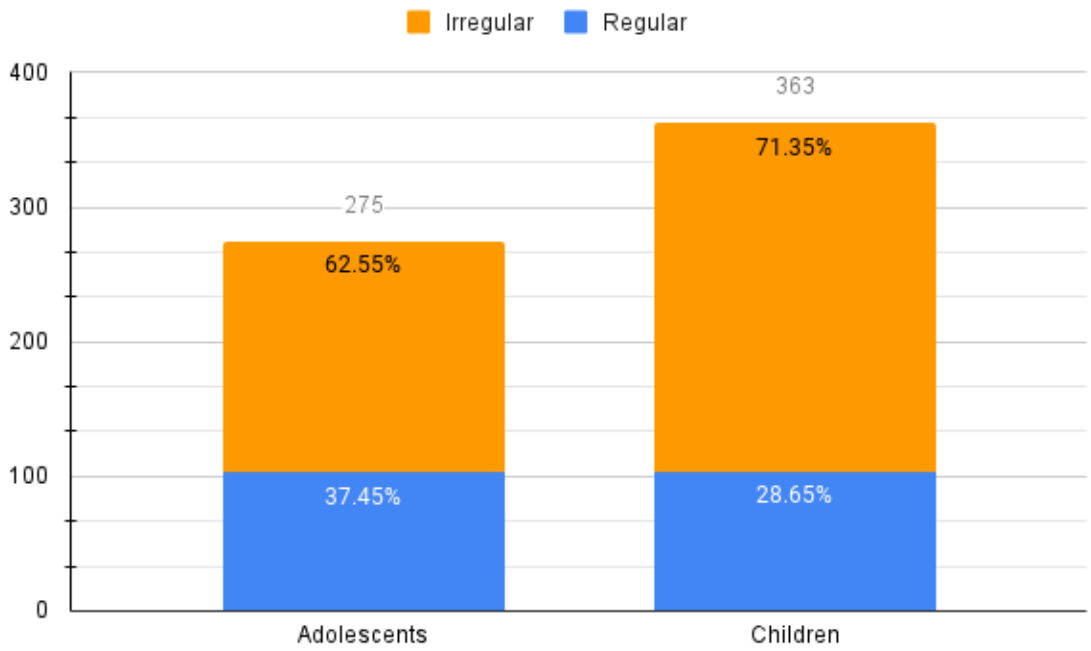

Figure 4

Drug pickup pattern for adolescents and children

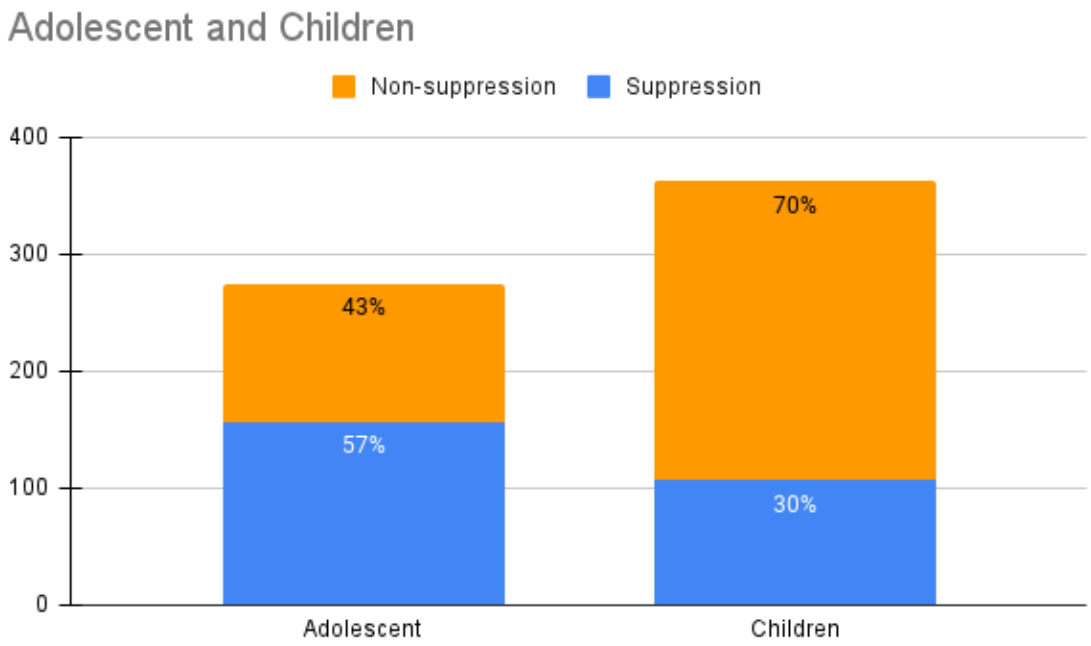

Figure 5

Viral suppression rate in adolescents and children

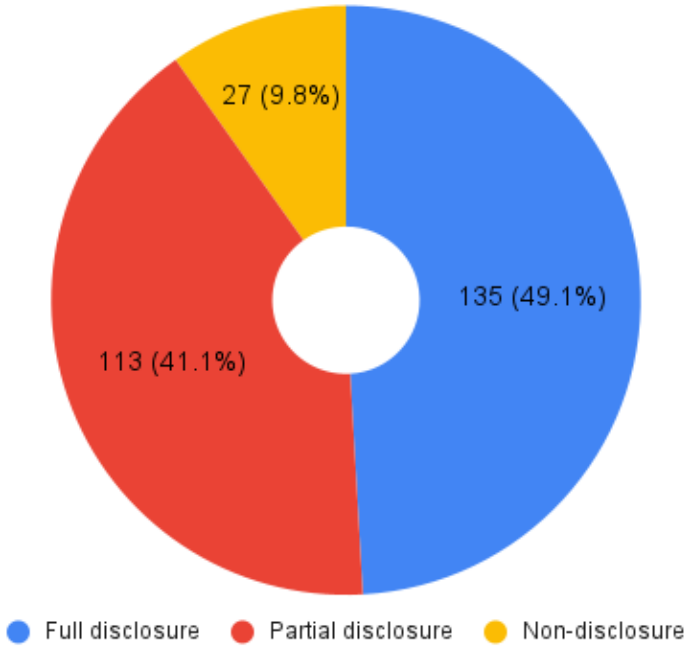

Figure 6

Pie chart showing the disclosure pattern in adolescents