

Viral load non-suppression among adolescents and youth living with HIV in South Africa



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Background: Despite the increased initiation and uptake of antiretroviral therapy (ART) in South Africa, some people living with HIV (PLHIV) who are on ART still have non-suppressed viral load (VL).

Objectives: This study aimed to determine the prevalence of VL non-suppression among adolescents and youth (aged 12 years – 24 years) living with HIV and on ART in South Africa, as well as the factors associated with it.

Method: Data from the 2017 South African national HIV prevalence, incidence, behaviour, and communication survey were analysed. The survey used a multistage-stratified cluster sampling design. A backward stepwise multivariable generalised linear model was used to identify factors associated with VL non-suppression.

Results: The study included 340 participants aged 12 years – 24 years, with a median age of 21 (interquartile range [IQR]: 18–23). The proportion of adolescents and youth living with HIV and on ART with non-suppressed VL was 19.2% (95% confidence interval [CI]: 14.4–25.3). Approximately 60% of the participants were not on ART. The odds of VL non-suppression were significantly higher among youth aged 15 years – 19 years (adjusted odds ratio [AOR] = 1.63 [95% CI: 1.24–2.13], $p = 0.001$) and aged 20 years – 24 years (AOR = 1.22 [95% CI: 1.06–1.41], $p = 0.005$) compared to adolescents aged 12 years – 14 years. The odds were significantly lower among individuals of other races (AOR = 0.80 [95% CI: 0.69–0.92], $p = 0.003$) compared to black African people.

Conclusion: Findings suggest a need for ART education and counselling as part of treatment support. In addition, the promotion of HIV awareness as part of strengthening the HIV treatment and prevention cascade.

Contribution: The article showed the prevalence of VL non-suppression and associated factors among adolescents and youth.

Keywords: HIV; antiretroviral treatment; viral load; non-suppression; adolescent; youth; South Africa.

Introduction

South Africa has the highest burden of HIV globally.¹ The HIV epidemic affects people of all age groups. In 2022, an estimated 7.6 million people were living with HIV (PLHIV) in South Africa. Of these, 36 000 were newly infected children and adolescents aged 0 years – 19 years and 56 000 were newly infected adolescents and youth aged 15 years – 24 years.² According to the United Nations Population Fund (UNFPA), persons aged 10 years – 19 years are considered adolescents, while persons aged 20 years – 24 years are considered youth.³ In high HIV prevalent low and middle income countries such as South Africa, programmatic monitoring of vertical versus horizontal transmission and viral suppression is critical in the national HIV response especially among adolescents and youth.^{4,5} This is because adolescents and youth face unique treatment and care challenges, which vary based on the manner they acquired HIV.⁴

Evidence shows that although there has been a substantial decline in HIV incidence and mortality in children under 14 years of age over the past decades, the epidemic remains a public health

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Dates: Received: 27 Feb. 2024 | Accepted: 30 May 2024 | Published: 25 Sept. 2024

How to cite this article: Molopa LO, Ginyana TP, Vondo N, et al. Viral load non-suppression among adolescents and youth living with HIV in South Africa. *S Afr J Infect Dis.* 2024;39(1), a629. <https://doi.org/10.4102/sajid.v39i1.629>

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challenge and a national priority in South Africa.^{2,6} The extent of viral load (VL) suppression among children and adolescents (0 years – 19 years) has changed little compared to older age groups between 2014 and 2020.⁵ Using data from 2005 to 2019, another study found that the prevalence of VL suppression (< 400 copies/mL) was 72.4% in children aged 0 years – 19 years and 85.7% in adults aged 15 years and older, indicating that younger people are less suppressed than adults.⁵ In 2017, the prevalence of VL suppression (< 50 copies/mL) was 47.2% among adolescents (10 years – 19 years), increasing to 50.5% in 2020.⁵

The decline in HIV incidence and mortality among children can be attributed to several interventions including early testing and improved access to antiretroviral therapy (ART).^{6,8} Successful prevention of vertical transmission of HIV from mothers to their babies either during pregnancy, at delivery, or through breastfeeding, has been cited as a major reason for the drastic reduction in paediatric HIV burden in the country.^{6,9} Among adolescents, efforts to accelerate progress towards the Sustainable Development Goals has resulted in health education, increased condom usage, the provision of incentivised interventions specifically among adolescent girls and the use of pre-exposure prophylaxis.^{10,11,12} Consequently, South Africa has the world's largest ART programme, with over 5.6 million PLHIV receiving ART in 2022, of whom 123332 were children aged 0 years – 14 years and 5574940 were adolescents and adults aged 15 years and older.¹³

Despite the scaling up of ART and more adolescents and youth receiving ART, VL non-suppression occurs in this population group.¹⁴ This poses a challenge to achieving the Joint United Nations Programme on HIV and AIDS (UNAIDS) 95-95-95 targets, which call for 95% of all PLHIV to know their HIV status, 95% of all people with diagnosed HIV to receive sustained ART, and 95% of all people on ART to have viral suppression.¹⁵ All three targets are key to ending the epidemic because HIV positive people on ART with undetectable VL do not transmit HIV through sex with HIV-negative individuals.¹⁶

The public health and individual benefits of the UNAIDS targets ultimately depend on achieving the third 95 across regions and/or populations. Therefore, it is important to better understand the factors driving VL non-suppression among children and adolescents in South Africa. Evidence shows that poor adherence to treatment and disengagement from care leads to VL non-suppression.^{17,18,19} Poor ART adherence and VL non-suppression are linked to the contextual factors associated with socio-demographic and socio-behavioural characteristics in specific settings.^{20,21,22}

This study aims to determine the prevalence and factors associated with VL non-suppression among adolescents and youth (12 years – 24 years) living with HIV and on ART in South Africa.

Research methods and design

Data source and study sampling

This secondary analysis used data from the 2017 South African National HIV Prevalence, Incidence, Behaviour, and Communication Survey collected using a complex multistage-stratified randomised cluster sampling design.²³ Briefly, the survey used a master sampling frame consisting of 15 visiting points or households drawn from 1000 randomly selected small layer areas sampled from 86000 such areas from the 2001 census updated in 2011.²⁴ The selected small areas layers were stratified by province, locality type (urban areas, rural informal or farm areas, and formal or tribal areas), race group, and sex.

Study procedures

Persons of all ages living in selected households were eligible for the survey. Detailed household questionnaires and age-appropriate individual questionnaires were administered to consenting or assenting individuals with parents and guardians answering on behalf of children under the age of 12 years. The questionnaires solicited information on demographic characteristics and HIV-related knowledge, attitudes, practices, and behaviours.

Dried blood spot cards were used to collect blood specimens from consenting individuals through a finger prick or heel prick in infants. These dried blood spot specimens were tested to determine, among others HIV serostatus, ART exposure (nevirapine, efavirenz, lopinavir, atazanavir and darunavir), and viral suppression. Specimens were sent to a centralised laboratory for HIV antibody testing using a three-step enzyme immunoassay (EIA) algorithm. Samples that tested positive for HIV during the first two EIAs (Roche Elecsys HIV Ag/Ab assay, Roche Diagnostics, Mannheim, Germany, and Genescreen Ultra HIV Ag/Ab assay, Bio-Rad Laboratories, California, USA) underwent a nucleic acid amplification test (COBAS AmpliPrep/Cobas Taqman HIV-1 Qualitative Test, v2.0, Roche Molecular Systems, New Jersey, USA) for final test result interpretation. Exposure to antiretroviral drugs in HIV positive specimens was determined using high-performance liquid chromatography (HPLC) coupled with tandem mass spectrometry. For VL testing, the lower limit for detection was 700 copies/mL – 800 copies/mL. This study used a sub-sample of adolescents and youth aged 12 years – 24 years who were tested for HIV and on ART.

Measures

Dependent variable

The primary outcome was VL non-suppression among adolescents and youth who tested positive for HIV, with a VL \geq 1000 copies/mL. In the analysis, the outcome is binary where 1 = VL \geq 1000 HIV RNA copies/mL and 0 = VL < 1000 HIV RNA copies/mL. The cut off is the standard used in the Population-based HIV Impact Assessments,²⁵ and the UNAIDS Undetectable = Untransmittable (U = U) definition,²⁶ which aligns with international standards.

Independent variables

Explanatory variables included age-group in years (12–14, 15–19, and 20–24), sex (male and female), race (black African people and other – white, mixed-race or Asian people), educational level (primary, secondary, and tertiary), locality type (urban areas, rural informal or tribal areas, and rural formal or farm areas) and socio-behavioural variables such as ever had sex in the last 12 months (yes and no), and self-rated health (excellent or good, and fair or poor).

Data analysis

All analyses were conducted in STATA version 15.1 (Stata Corporation, College Station, Texas, USA) using weighting to adjust for the complex multilevel unequal sampling probabilities in the survey design. Summary statistics were used to describe the study sample and VL non-suppression. A multivariable generalised linear model (GLM) with a backward stepwise selection method was fitted to determine factors associated with VL non-suppression. Adjusted odds ratio (AOR) with 95% confidence intervals (CI) and *p*-values less than 0.05 were used to determine the direction and the strength of the association.

Ethical considerations

Ethics approval to conduct the study was granted by the Human Sciences Research Council (HSRC) Research Ethics Committee (REC: 4/18/11/15), and the Division of Global HIV and TB (DGHT) and the Centre for Global Health (CHG) of the Centers for Disease Control and Prevention (CDC). Written and verbal informed consent was obtained from all individual participants involved in the study.

Results

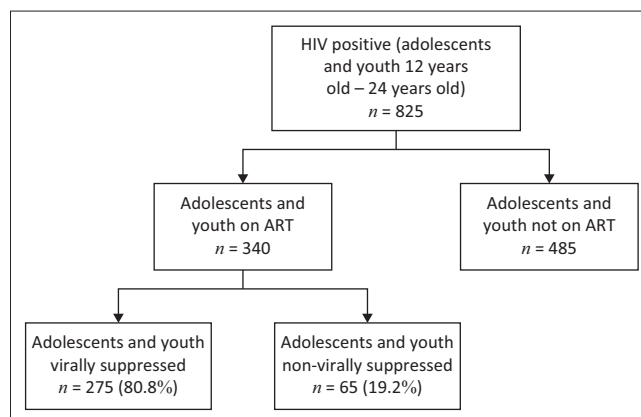
Figure 1 shows that of the 825 HIV positive adolescents and youth in the study sample, 340 (41.2%) were on ART. Almost 60% were not on ART despite living with HIV.

Sample characteristics

Table 1 shows the characteristics of the study sample (*n* = 340), the median age and interquartile range (IQR) were 21 (IQR: 18–23). Most participants were aged 20 years – 24 years old (62%), female (68%), had a secondary-level education (87%), and almost 50% lived in rural informal or tribal areas. The majority reported having engaged in sexual activity in the last 12 months (79%) and rated their health as poor or fair (66%).

Viral load non-suppression prevalence and sample characteristics

Table 2 shows the prevalence of VL non-suppression by sample characteristics. Viral load non-suppression was significantly higher among those who reported having had sex in the last 12 months. Although not statistically significant, the prevalence of VL non-suppression was also higher among adolescents aged 12 years – 14 years, males,



ART, antiretroviral therapy.

FIGURE 1: Selection of children and youth included in the study.

TABLE 1: Characteristics of HIV positive participants aged 12 years – 24 years on antiretroviral therapy (*n* = 340), South Africa, 2017.

Variables	<i>n</i> †	%
Age in years		
12–14	23	7.8
15–19	105	30.1
20–24	212	62.1
Sex		
Male	84	30.9
Female	256	68.1
Race groups		
Black African people	329	96.4
Other	11	3.6
Education level		
No education or primary	19	8.4
Secondary	141	87.4
Tertiary	10	4.2
Locality type		
Urban areas	126	45.7
Rural informal or tribal areas	174	46.6
Rural formal or farm areas	40	7.7
Had sex in the last 12 months		
Yes	168	79.3
No	38	20.7
Self-rated health		
Excellent or good	95	34.4
Fair or poor	177	65.6

†, Totals do not all add up to the study sample because of non-response or missing data.

other race groups, those with no education or only primary education, those who reside in rural informal or tribal areas, and those who reported fair or poor self-rated health.

Factors associated with viral load non-suppression

Figure 2 shows the determinants of VL non-suppression in adolescents and youth aged 12 years – 24 years who tested HIV positive and were on ART. The odds of VL non-suppression were significantly higher among the youth aged 15 years – 19 years (AOR = 1.63 [95% CI: 1.24–2.13] *p* = 0.001) and the youth aged 20 years – 24 years (AOR = 1.22 [95% CI: 1.06–1.41] *p* = 0.005) compared to adolescents aged 12 years – 14 years. The odds of VL non-suppression were significantly lower among other races (AOR = 0.80 [95% CI: 0.69–0.92], *p* = 0.003) compared to black African people.

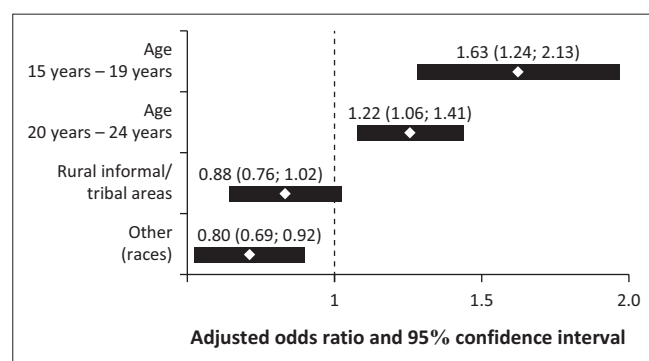
TABLE 2: Viral load non-suppression by sample characteristics among adolescents and youth aged 12 years – 24 years who tested HIV positive and were on antiretroviral therapy ($n = 340$), South Africa, 2017.

Variables	n^{\dagger}	% [‡]	95% CI	p
Age in years				0.211
12–14	23	35.8	14.9–64.1	-
15–19	105	20.5	12.6–31.5	-
20–24	212	16.6	10.9–24.3	-
Sex				0.544
Male	84	21.9	13.2–34.1	-
Female	256	18.1	12.5–25.5	-
Race groups				0.893
Black African people	329	19.2	14.2–25.4	-
Other	11	21.0	4.9–57.8	-
Educational level				0.410
No education or primary	19	28.6	8.7–62.8	-
Secondary	141	15.2	8.6–25.5	-
Tertiary	10	28.4	7.1–67.5	-
Locality type				0.643
Urban areas	126	16.4	10.0–25.8	-
Rural informal or tribal areas	174	21.8	14.7–31.0	-
Rural formal or farm areas	40	20.5	7.2–46.2	-
Had sex in the last 12 months				0.030
Yes	168	21.3	13.8–31.3	-
No	38	7.6	2.9–18.4	-
Self-rated health				0.231
Excellent or good	95	15.8	8.9–26.5	-
Fair or poor	177	19.4	12.8–28.3	-

CI, confidence interval.

[†], totals do not all add up to the study sample because of non-response/missing data.

[‡], row proportions of viral load non-suppression relative to suppressed viral load.



Note: Adjusted odds ratios with 95% confidence intervals in parentheses, calculated using a multivariate generalised linear model.

FIGURE 2: Coefficient plot of the final model for factors associated with viral load non-suppression among adolescents and youth aged 12 years – 24 years who tested positive for HIV and on antiretroviral therapy.

Discussion

This nationally representative study revealed two very disturbing findings. Firstly, almost 60% of adolescents and youth living with HIV were not on ART, possibly undiagnosed. Secondly and the main outcome of our study, was that almost a fifth of adolescents and youth on ART were not virally suppressed. This is lower than the VL non-suppression observed in the adult population.²² Similar observations were made in other Eastern and Southern African countries such as Malawi, Kenya, Uganda, and Zimbabwe.^{18,27,28,29} This remains a concern given the ongoing efforts to end the epidemic in the country, and the burden of HIV among youth especially females aged 15 years – 24 years old.

The prevalence of VL non-suppression varied by selected socio-demographic and socio-behavioural factors. These findings are consistent with other studies that found VL non-suppression varying by age, locality type, educational level, and race.^{28,30,31} The study also found that VL non-suppression was higher among those who reported fair or poor self-rated health. An important observation in our study is that VL non-suppression was significantly higher among adolescents and youth who reported sexual activity in the past 12 months, as observed elsewhere.^{32,33,34} This is particularly worrying when one also looks at low self-report condom use at last sex (38.9%), consistent condom use (28.1%) and condom use among high-risk groups such as black African men (37.5%) and women (35.6%), coupled with rates on multiple sexual partners for males (25.5%) and females (9.0%), particularly among young people.^{21,35} Therefore, when including the high proportion not on ART, 62.9% could transmit HIV.⁷

The final model showed that the odds of VL non-suppression in adolescents and youth aged 12 years – 24 years were age-group specific, more likely among adolescents (15 years – 19 years) and black African people. As observed in other studies, this analysis showed that VL non-suppression was more likely among adolescents.^{29,36} Literature suggests that VL non-suppression among adolescents may be because of ignorance,³⁰ non-adherence, which may be attributed to poverty, access (travelling cost and long travelling times and distance), a lack of support (family support), and negative peer pressure because of stigma and health systems barriers among others.^{29,36,37,38} This underlines the need for differentiated services and indicates a need to improve age-appropriate access and support interventions tailored for PLHIV in the population who are being left behind. Such interventions could include strengthening adolescent – and youth-friendly HIV services, and improving family and peer support interventions.^{1,39} In addition, programmes providing care to adolescents should focus on providing routine and intensive adherence counselling to prevent treatment interruptions that can result in VL non-suppression.¹⁸

Limitations

The study has several limitations. The behavioural data were self-reported, which introduces reporting bias. However, the survey questions used have been validated over several survey rounds in South Africa. The cross-sectional design cannot establish causality but, only the presence or absence of associations. The small sample size and large CI reduce the statistical power. Another limitation is the fact that the study could not differentiate between those with perinatally acquired HIV and those who acquired it horizontally. The analysis is also limited because of the survey data being over 5 years old, which predates the introduction of dolutegravir (DTG), a new effective and better tolerated antiretroviral agent. Consequently, the findings may not reflect the current landscape as increasing use of DTG should improve treatment outcomes. Another possible limitation is the use of a VL of 1000 copies/mL as a cut-off for undetectable VL. However,

evidence shows that it is relevant for resource constrained settings where the use of dried blood sample as in the current survey is more feasible.⁴⁰ Furthermore, a cut-off of 1000 copies/mL has greater utility regarding intervention decision making as it indicates virologic failure when treatment fails to suppress the VL.⁴¹ This study is based on nationally representative data for a unique age group, the same design can be used to track changes, and/or progress made overtime.

Conclusion

The study highlights the need for behavioural change interventions as part of ART education and counselling to reduce both the likelihood of VL non-suppression and the risk of HIV transmission especially among adolescent. Additionally, there is a need for age group specific adolescent and youth-friendly healthcare systems and innovative targeting to improve HIV treatment outcomes in this population group. The study also underscores the importance of disclosure, ART initiation and adherence among those with horizontally acquired HIV.

Acknowledgements

The authors would like to acknowledge the field staff who collected data for the fifth South African HIV Prevalence, Incidence, Behaviour and Communication Survey, which was used for secondary analysis in this article. Further acknowledgement is extended to the Human Sciences Research Council for managing and preparing the data.

The abstract was presented at the Human Sciences Research Council emerging researchers conference at the Lagoon Beach Hotel and Conference Centre, Cape Town on 18 September – 20 September 2023. <https://hsrc.ac.za/wp-content/uploads/2023/09/HSRC-Emerging-Researchers-Conference-Abstract-Booklet-1-2.pdf>.

Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

S.M. conceived the study. S.M, M.M. and L.O.M. analysed the data. T.P.G., N.V., R.M., G.M., N.Z., K.Z., and L.S. read, revised and assisted in writing the manuscript.

Funding information

Core funding for the survey was made available by the Centers for Disease Control and Prevention (CDC).

Data availability

Supporting data are available on request from the corresponding author, L.O.M.

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