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95-95-95 HIV indicators among children younger than 15 years in South Africa: results from the 2017 national HIV prevalence, incidence, behaviour, and communication survey

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Abstract

Background Early detection and initiation of care is crucial to the survival and long-term well-being of children living with HIV (CLHIV). However, there remain challenges regarding early testing and linking of CLHIV for early treatment. This study examines the progress made towards achieving the 95-95-95 HIV indicators and associated factors among CLHIV < 15 years in South Africa.

Methods The data was collected as part of the 2017 cross-sectional, multistage cluster randomized population-based household National HIV survey. Age-appropriate structured questionnaires were utilized to gather sociodemographic data, HIV-related knowledge, risk behaviours, and health-related information. Blood samples were collected to test for HIV serology, viral load suppression, and antiretroviral usage. Backward stepwise multivariable generalized linear regression models were fitted to identify factors associated with the 95-95-95 HIV indicators. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) are shown, and $p < 0.05$ indicates statistical significance.

Results A total of 12,237 CLHIV < 15 years were included (median 8 years, interquartile range 4–11 years). HIV prevalence was 2.8% (95% CI: 2.4–3.3). Overall, 40.0% of the CLHIV were tested and knew their status (first 95%), and among these, 72.6% (95% CI: 61.7–81.3) were on antiretroviral therapy (ART) (second 95%), and 95.0% (95% CI: 88.4–97.9) of these were virally suppressed (third 95%). Among CLHIV, the odds of testing and knowing the HIV-positive status were significantly higher among children whose health was rated as fair/poor than excellent/good [AOR = 1.32 (95%CI: 1.05–1.67), $p = 0.022$], and were significantly lower among females than males [AOR = 0.82 (95% CI: 0.71–0.95), $p = 0.009$], and were significantly lower among those attending private healthcare facilities than public health facilities [AOR = 0.64 (95% CI:0.57–0.74), $p < 0.001$]. Among those who knew their HIV-positive status, the odds of being on ART were significantly higher among children residing in farm areas than urban areas [AOR = 1.40 (95%

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CI:1.05–1.86), $p=0.017$], and were significantly lower among children attending private healthcare facilities [AOR = 0.44 (95% CI:0.36–0.54), $p<0.001$].

Conclusions Awareness of HIV status and initiation of treatment in children was low. The findings highlight the need to improve HIV status awareness and disclosure to children. The findings underscore the need for targeted interventions and programs tailored for CLHIV in urban areas.

Keywords HIV, ART, Viral suppression, children

Background

Globally, an estimated 1.4 million children younger than 15 years old were living with HIV in 2023, with 87% of them living in sub-Saharan Africa [1, 2]. The number of new HIV infections among children declined by 62% between 2010 and 2023. However, progress in recent years has stagnated [1]. Despite the availability of life-saving antiretroviral therapy (ART) and prevention of mother-to-child transmission (PMTCT) services, 120,000 new infections and 76,000 HIV-related deaths in children were reported globally in 2023, a significant decline from 160,000 new infection and 120,000 HIV-related deaths in 2016 [3]. Globally, children still lag behind adults in accessing HIV services despite the Sustainable Development Goals and the United Nations Programme for HIV/AIDS (UNAIDS) 95-95-95 strategies emphasizing the critical need for attention to be given to children and adolescents [4]. The United Nations Children's Fund (UNICEF) estimated that four in ten infants living with HIV had missed out on a timely diagnosis in 2022 [2], highlighting the need for improved access to HIV services for children.

The HIV epidemic in South Africa remains the highest in the world. accounting for 7.7 million people living with HIV (PLHIV) in 2023, of whom 160,000 are children younger than 15 years compared 7.2 million PLHV, of whom 280,000 were children younger than 15 years in 2017 [5]. Although HIV infection among children in South Africa has decreased, the number of new infections is worrisome, despite 97% coverage among pregnant women initiated on ART for PMTCT [5, 6]. Given the continued risk of transmission among infants postpartum, the World Health Organization (WHO) recommends that infants born to mothers living with HIV be tested for HIV by the age of two months of age, during breastfeeding, and when breastfeeding ends [7]. Older children, especially siblings of persons infected with HIV, should also be tested in high-prevalence regions [8]. However, gaps remain in early HIV testing and diagnosis, and linkage to treatments for CLHIV to care [9, 10].

The HIV care cascade has been widely used among various populations to identify progress at critical stages along the continuum of care, from HIV testing and diagnosis, linkage to care, retention in care, treatment, and viral suppression [8, 11]. This tool allows for the monitoring and identification of key gaps in HIV prevention and care to inform targeted interventions to support ending the HIV epidemic by 2030 [8, 11]. Globally, evidence suggests that children younger than 15 years of age are left behind in the HIV care cascade. In 2023, 66% of CLHIV aged < 15 years knew their status, of whom 86% were on treatment, and of those on treatment, 84% were virally suppressed [1]. Limited data exist on the HIV indicators among CLHIV in Sub-Saharan African countries, including South Africa [4, 12]. This study examines progress made towards achieving the 95-95-95 HIV indicators and associated factors among children younger than 15 years in South Africa using data from the 2017 National HIV Prevalence, Incidence, Behaviour, and Communication Survey (SABSSMV).

Methods

Study design and sampling

This secondary data analysis used data from SABSSMV the 2017 South African National HIV Prevalence, Incidence Behaviour and Communication Survey, a cross-sectional, multistage cluster randomized population-based household survey described in detail elsewhere [13]. Briefly, 15 households were randomly selected from 1000 small area layers (SALs) selected from 84,907 SALs released by Statistics South Africa's 2015 National population sampling frame [14]. An additional 457 SALs were sampled in 13 priority districts to yield more reliable HIV estimates at that level. The sampled SALs were stratified by province, locality type [urban (formal urban, squatter settlements), rural informal/tribal areas(rural informal areas in which tribal chiefs are regarded as the key agents for law.

enforcement) and rural formal (farm areas(a farm producing agricultural products intended for the market, usually registered for value-added tax (VAT) and income tax)], and race group as defined by Statistics South Africa [15].

Study procedure

Persons of all ages living in selected households were eligible to participate in the study. Youth and adults who participated provided written or verbal consent, including parent/guardian informed consent for youth under 18 years of age and verbal assent for those aged 12–17 years

of age. A household questionnaire was administered to the head of the household, and three age-appropriate questionnaires were administered to persons of different age groups in the selected households (parent and guardian questionnaire for children 0–11 years old, adolescent questionnaire for adolescents 12–14 years old, and adult questionnaire for those 15 years and older). The questionnaires solicited information on socio-demographic characteristics (sex, age, race, locality type, and province), HIV-related knowledge, awareness of HIV status, attitudes, practices, risk behaviours, and health-related factors.

Dried blood spots (DBS) were also collected from participants who consented to HIV testing. Blood samples were collected by finger prick in children, youth, and adults and by heel prick in infants younger than 2 years. The samples were tested for HIV-antibodies, antiretrovirals (ARVs), viral load, and HIV drug resistance [13].

The sub-sample in this analysis was restricted to children < 15 years old with i) a known HIV status from the survey samples or self-reported(includes reported by parents/guardians, ii) ARV test results, and iii) HIV viral load results HIV viral load suppression (VLS) was determined using a laboratory cut-off of < 1000 copies of HIV RNA/mL [13].

Measures

Dependent variable

The primary outcome measures were the UNAIDS 95-95-95 indicators defined as the first 95 (Diagnosed) children (aged < 15 years) who tested positive for HIV and whose parents/guardians were aware of their positive status or children who were informed and therefore were aware of their HIV positive status; second 95 (on ART), children whose parents/guardians were aware of their positive status or children who were informed of their positive status and were on ART; third 95 (virally suppressed), children whose parents/guardians were aware of their positive status or children who were informed of their positive status and were on ART and were virally suppressed.

Independent variables

Explanatory variables included sociodemographic characteristics such as sex (male and female), race (black Africans and others which include whites, coloureds, and indians), locality type (urban areas, rural informal/tribal areas, and rural formal/farm areas), and nine provinces. Health-related factors were self-rated health (excellent/good, fair and poor), last time the child was seen by a healthcare professional (Within the past six months, More than six months but not more than 12 months ago, More than 12 months ago, and Never), whether the child was admitted to the hospital for any illness during the last 12 months (yes and no), number of times the child was admitted to hospital during the last 12 months [0–3 (included no admission due to low numbers), 4–6 and 7 times and more], total time (in days) spent in hospital during the last 12 months [0–3 (included those who visited the hospital but were never admitted due to small numbers), 4–6 and 7 days and more], type of facility where the child usually obtains healthcare (government and private),

Statistical analysis

Stata version 17.0 (Collage Station, TX: Stata Corporation) was used for all data processing and statistical analysis. The "svy" command was used to account for the complex survey design. Descriptive statistics summarised sociodemographic characteristics, health-related factors, and HIV treatment cascade. Pearson's Chi-square test was used to assess differences between categorical variables. Three multivariate generalised linear regression models were fitted using a backward stepwise selection method to identify factors associated with each 95-95-95 HIV indicator. Adjusted odds ratios (AOR) are presented with 95% confidence intervals (CI) and a p-value less than 0.05 was used to determine statistical significance.

Ethical consideration

Ethics clearance to conduct the survey was granted by the Human Sciences Research Council Research Ethics Committee (REC 4/18/11/15) and the US Centers for Disease Control and Prevention (CDC).

Results

Sample characteristics

The sample had a total of 12 237 children aged < 15 years, and a median age of 8 years (interquartile range [IQR]: 4–11 years) and were mainly Black Africans (85.7%). Half of the participants were males (50.1%). Just over half of the participants resided in urban areas (54.0%). Most participants were from KwaZulu-Natal province (21.9%). The majority (94.0%) of the participants' parents and/or guardians rated their children's health status as excellent or good, 44.0% had been seen by a healthcare professional within the past six months and 93.9% obtained healthcare from government facilities. A small proportion of participants had been hospitalized during the past 12 months (3.4%). Of those who reported hospitalization, most (89.0%) were admitted 0–3 times and 55.8% of them spent 0–3 days in hospital (Supplementary Table 1).

HIV prevalence

Overall, the weighted HIV prevalence in this study population was 2.8% (95% CI: 2.4–3.3). Figure 1 shows that HIV prevalence among children aged < 15 years by province. Relative to all the provinces in South Africa the

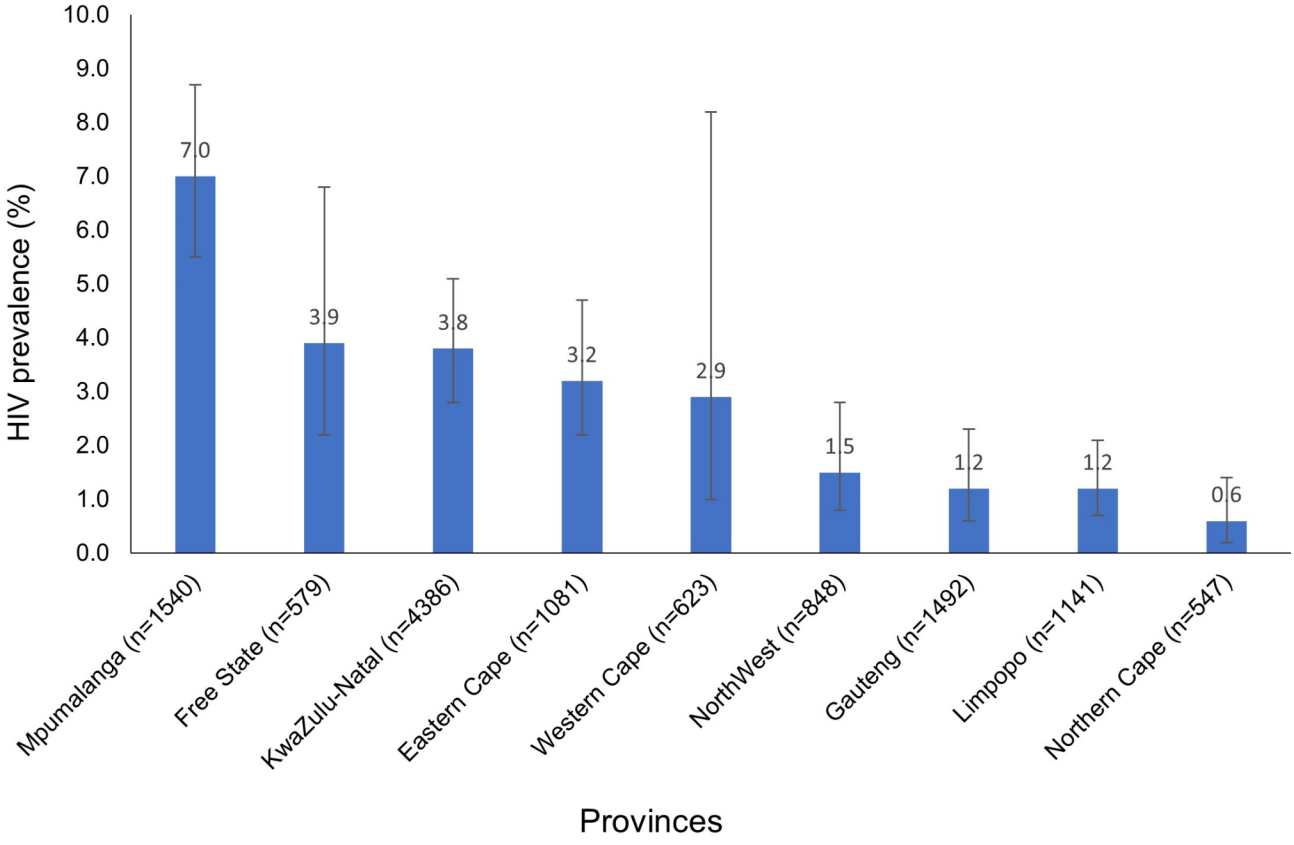

Fig. 1 HIV prevalence by province among children aged < 15 years, South Africa, 2017 national survey (*n* = 12 237)

prevalence of HIV was highest in Mpumalanga (7.0%) and lowest in Northern Cape (0.6%).

HIV prevalence by demographic characteristics

There was no significant difference in HIV prevalence by sex, with 3.0% (95% CI 2.4–3.8) for females and 2.6% (95% CI 2.1–3.2) for males. There was also no statistically significant difference in HIV prevalence by locality type, with 2.4% (95% CI 1.8–3.2) in urban areas, 3.4% (95% CI 2.7–4.1) in rural informal/tribal areas, and 3.2% (95% CI 1.5–6.7) in rural formal/farm areas (Supplementary Table 1).

UNAIDS 95–95–95 HIV testing and treatment indicators

Table 1 shows that of the CLHIV aged < 15 years, 40% (95% CI: 32.9–47.6) were diagnosed and aware of their status (the first 95). Of the CLHIV who were aware of their status, 72.6% (95% CI: 61.7–81.3) were on ART (the second 95). Of the CLHIV who were aware of their status and who were on ART, 95% (95% CI: 88.4–97.9) were virally suppressed (the third 95).

The gap in reaching the first 95 was higher among girls (33.7%), those in farm areas (22.3%), those reporting excellent/good self-rated health status (40.2%), those last seen by a health professional more than 12 months ago (27.1%), those who were not hospitalized in the past 12 months (43.1%), and who sought healthcare services from government facilities (45.6%). The gap in reaching the second 95 was higher among males (66.8%), African children (72,2%), those in urban areas (66.4%), and those reporting excellent/good self-rated health status (68.9%), those who were seen by a health professional more than one year ago (54.4and those who were hospitalized in the past 12 months (51.7%). Overall, the third 95 goals was achieved among children aged < 15 years. Stratified analysis showed small gaps in boys (94.0%), those in tribal areas and farm areas (93.9%), those with excellent/good self-rated health (92.7%), those who were last seen by a healthcare professional more than 12 months ago (93.0%) and those who were hospitalized in the past 12 months.

Factors associated with HIV testing and treatment indicators

Figure 2 shows multivariate models of factors associated with the UNAIDS 95–95–95 HIV testing and treatment indicators amongst children aged < 15 year. The odds of HIV diagnosis and knowing their HIV-positive status (first 95) were significantly higher among children whose health was self-rated as fair or poor than excellent or good [AOR = 1.32 (95%CI: 1.05–1.67),$p = 0.020$]

Table 1 95–95–95 HIV treatment indicators by sociodemographic and health-related factors among children aged < 15 years, South Africa, 2017 national survey

	Diagnosed and aware of positive HIV status (1st 95)			*P* value	On ART (2nd 95)			*P* value	Virally suppressed (3rd 95)			*P* value
	n	%	95% CI		*n*	%	95% CI		*n*	%	95% CI	
Age (Years)												
0–14	408	40.0	32.9–47.6		146	72.6	61.7–81.3		109	95.0	88.4–97.9	
Sex				0.051				0.176				0.624
Male	198	47.4	38.1–56.9		79	66.8	51.0-79.6		57	94.0	81.4–98.3	
Female	210	33.7	24.6–44.2		67	80.2	65.8–89.5		52	96.0	88.1–98.8	
Race				0.002				0.340				< 0.001
African	396	42.6	35.9–49.6		143	72.2	61.2–81.0		106	96.3	89.6–98.7	
Other	12	6.5	1.1–29.3		3	100.0			3	22.1	2.4–76.5	
Locality type				0.354				0.292				0.766
Urban	150	44.8	31.7–58.7		60	66.4	49.1–80.2		38	96.3	87.2–99.0	
Tribal areas	222	37.5	30.1–45.6		79	77.5	62.7–87.5		65	93.9	81.4–98.2	
Farm areas	36	22.3	5.6–58.1		7	90.8	47.0-99.1		6	93.9	56.6–99.5	
Self-rated health				0.029				0.255				0.143
Excellent/good	321	40.2	32.2–48.9		110	68.9	55.6–79.7		79	92.7	83.3–97.0	
Fair/Poor	51	70.9	43.5–88.6		36	82.0	61.3–95.3		30	100.0		
The last time the child was seen by a health professional				0.006				0.327				0.808
Within the past six months	187	57.0	46.6–66.8		88	79.1	64.5–88.7		70	94.1	83.5–98.1	
More than six months but not more than 12 months ago	62	35.0	17.4–57.9		24	63.8	36.8–84.2		16	96.7	78.8–99.6	
More than 12 months ago	94	27.1	16.9–40.4		23	54.4	26.8–79.6		15	93.0	70.5–98.7	
Never	26	65.9	43.1–83.2		9	72.9	35.4–93.0		6	100.0		
Facility type				0.003				0.114				
Government	359	45.6	37.6–53.8		145	72.7	61.8–81.4		109	95.0	88.4–97.9	
Private	12	6.3	0.8–35.4		1	0.0						
Hospitalisation for any illness in the past 12 months				0.001					0.178			0.385
Yes	22	83.9	61.2–94.6		14	51.7	20.4–81.7		10	88.6	48.0-98.5	
No	*349*	*43.1*	*35.2–51.5*		*132*	*75.1*	*64.1–83.7*		*99*	*95.5*	*88.6–98.3*	

Key: CI-confidence interval; ART-antiretroviral therapy

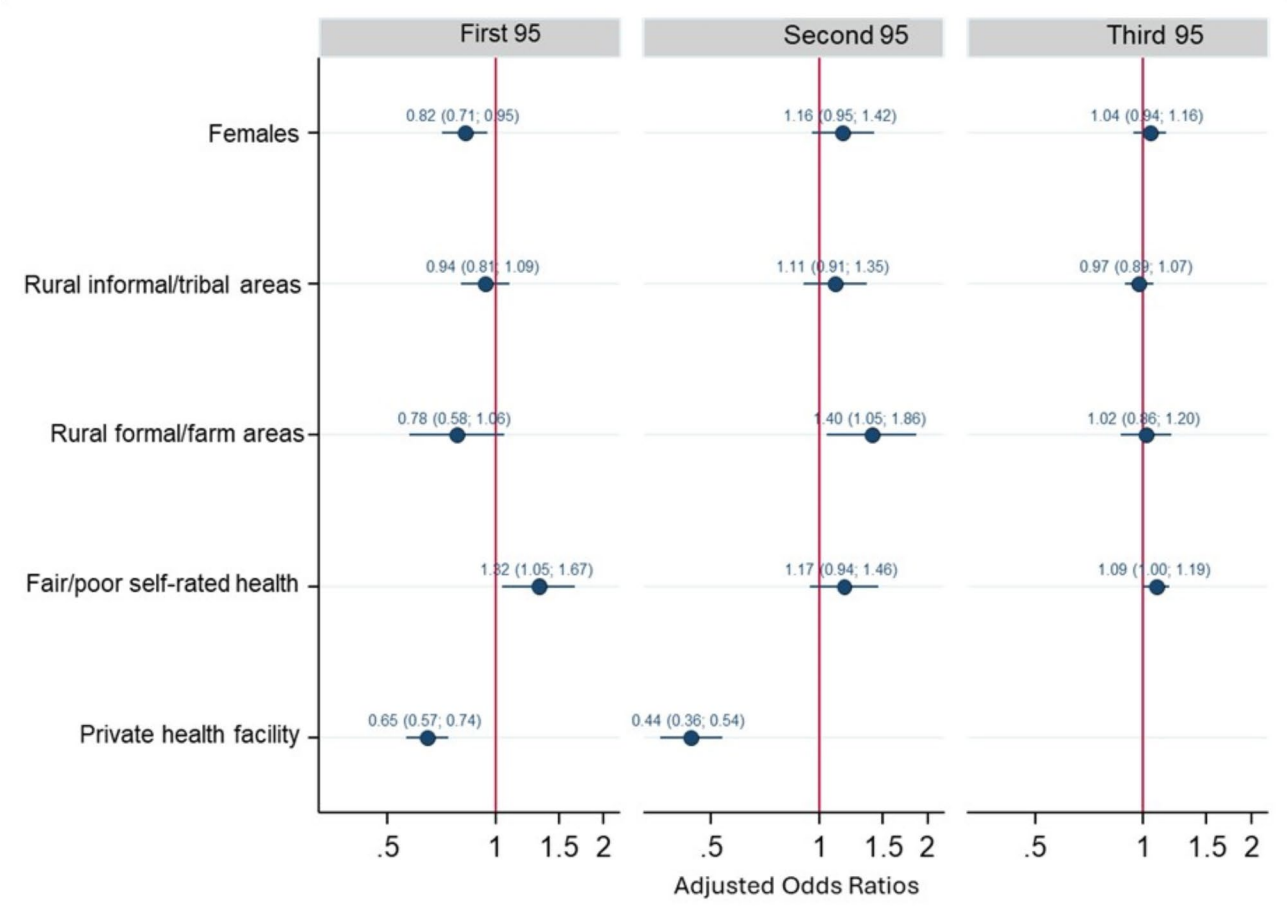

Fig. 2 Multivariate models of factors associated with the UNAIDS 95–95–95 HIV testing and treatment cascade amongst children aged < 15 years, South Africa, 2017 national survey

and lower among those attending private health facilities [AOR = 0.65 (95% CI:0.57–0.74), $p < 0.001$]. The odds were significantly lower among females compared to males [AOR = 0.82 (95% CI: 0.71–0.95), $p = 0.009$].

The odds of HIV diagnosis, knowing HIV-positive status, and being on ART (second 95) were significantly higher among children residing in farm areas compared to urban areas [AOR = 1.40 (95% CI:1.05–1.86), $p = 0.021$], and were significantly lower among children attending private healthcare facilities compared to public health facilities [AOR = 0.44 (95% CI:0.36–0.54), $p < 0.001$].

The odds of HIV diagnosis, knowing HIV-positive status, being on ART, and being virally suppressed (third 95) were significantly higher among children whose health was self-rated as fair or poor than excellent or good [AOR = 1.09 (95% CI:1.00-1.18), $p = 0.05$].

Discussion

Data from SABSSMVI showed an HIV prevalence of 2.8 in children < 15 years old in South Africa in 2017. The highest prevalence was reported in Mpumalanga province and the lowest in Northern Cape province. 40% of CLHIV < 15 years were diagnosed and aware of their status (first 95), of those who were aware of their status, 72.6% were on ART (second 95), and of those who were on ART, 95% were virally suppressed (third 95). The likelihood. testing and knowing the HIV-positive status were higher among children whose health was rated as fair or poor than excellent or good was lower among females than males and was lower among those attending private healthcare facilities than public health facilities. Among those who knew their HIV-positive status the likelihood of being on ART was higher among children residing in farm areas than urban areas, and was lower among children attending private healthcare facilities. Among those who knew their HIV-positive status and were on ART, the likelihood of being virally suppressed was higher among children with self-rated health as fair or poor than excellent or good.

Evidence shows that over time there has been a substantial decrease in HIV among children in South Africa where the prevalence was 5.6% in 2002, 3.3% in 2005, 2.5% in 2008, 2.4% in 2012, and 2.7% in 2017 [12, 15–20]. Nevertheless, the HIV prevalence among children

in South Africa is still high compared to other Eastern and Southern African countries where the prevalence was 0.5% in Uganda, 0.7% in Kenya, and 2.1% in Lesotho [21–24].

At the provincial level, changes have occurred between the years 2005 and 2017 in HIV prevalence, where Kwazulu-Natal had the highest prevalence of HIV among children < 15 years old in 2005 (7.9%) and Western Cape had the lowest prevalence at 0.3%. In 2017, Mpumalanga had the highest HIV prevalence in children (7%), followed by Free State(3.9%) and KZN (3.8%).

This analysis is indicative of the progress made to reduce HIV in children including mother-to-child transmission where prevalence has declined from 23% in 2003 to 0.7% in 2019 [16]. The decrease in HIV prevalence in South Africa among children has been attributed to the extensive PMTCT program and the scaling-up of the universal test and treat program (UTT) [25, 26]. Compared to other countries in the Southern African Development Community (SADC) where only half of the member states have reached 100% coverage of ART among pregnant women, South Africa has made significant progress with a coverage of 97% resulting in a significant decline in vertical transmission of HIV from 16% in 2010 to 3% in 2020 [5, 27]. Nevertheless, there is a need for continued strengthening of PMTCT, maternal and child health services, including paediatric HIV diagnosis, and care to realize the 2030 target of ending AIDS as a public health threat [16].

However, despite this progress, our findings suggest that substantial gaps still need to be addressed along the HIV care cascade for children in South Africa. In line with observations made in other Sub-Saharan African countries [23, 28], the study found that awareness of HIV status was less than 50%. Without testing, and therefore opportunity to start treatment, CLHIV may have poor health outcomes, including a high mortality rate in the early stages of their lives [29]. Babies born to mothers living with HIV who are unaware of their status or never received antenatal care during their pregnancy are normally left out of the infant or newborn testing program and are at high risk of HIV transmission and disease progression while they remain undiagnosed [30–33]. Achieving the first 950 of the UNAIDS targets will ensure that all CLHIV access life-saving treatment.

The findings show that less than 80% of children diagnosed with HIV, who were aware of their status were on ART. Evidence shows that of 1.4 million CLHIV worldwide, 84% of them received treatment in 2023, a significant improvement from 53% in 2019 [34]. However, the gap between adult and child treatment coverage remains albeit with some improvements [1, 5, 13]. In South Africa, the proportion of CLHIV receiving ART increased from 55% in 2016 to 63% in 2023 [5, 35]. However, a significant proportion of CLHIV in South Africa remains untreated despite universal access to ART [5]. Improving access to treatment and retention in the care of newly diagnosed children in the ART program is vital for viral load suppression and the overall health of the children.

Although the proportion of children who know their HIV status is small at 40%, and 72.5% are on treatment, the overwhelming majority (95%) of children on ART are virally suppressed. Other surveys in sub-Saharan African countries have shown low viral suppression among CLHIV, with Kenya 2018 reporting 67%, followed by 54% in Lesotho and 39.3% in Uganda [22–24]. Notable advancements in the quality of care for CLHIV include the adoption of UTT and age-appropriate ART dosage, improved formulation of paediatric ARVs, as well as routine viral load testing for ART monitoring [36, 37].

The HIV care cascade models underscore the important role of public healthcare settings in reaching the HIV testing and treatment indicators, and the need to expand these effective testing and treatment protocols to private sector facilities to reach those seeking care there. The finding that ART uptake among children in rural areas was higher than in urban areas is contrary to other studies that have found delayed initiation of ART in rural areas [38, 39]. This is also reflected in the different sizes of paediatric ART programmes in the respective settings [39]. Urban areas may be affected by the improper balance between demand and supply of services (ART stockouts), mobility, and crowded facilities leading to poor retention and/or opting out after ART initiation by parents/guardians of eligible children. However, more studies are needed on barriers to accessing ART among children given the ever-increasing availability of ART in these settings.

This study has some limitations that must be considered when interpreting the results. The participation rate among children in the national HIV population-based surveys is generally low, and in SABSSMV participation (interviewed and tested for HIV) was 29.2% compared to adults (15 years and older) at 70.8% [2]. The wide confidence intervals for Western Cape and Free State provinces may be due to provincial data weighting. The analysis is limited to assessing associations and cannot infer causality due to the cross-sectional design of the survey. Nevertheless, this study presents nationally representative data on HIV testing and treatment indicators among children < 15 years of age that can be generalized for this population group in South Africa.

Conclusion

This study highlights the need to improve the HIV testing and treatment indicators among children aged < 15 years. The emphasis is on making progress in testing and treatment coverage in specific populations and

geographical settings. Although mother-to-child transmission (MTCT) of HIV occurs at an extremely low rate (< 5%) in South Africa, interventions should include the mobilization of resources towards educational campaigns focusing on the risks of MTCT, benefits of seeking antenatal care, UTT among women of childbearing age, and addressing stigma and discrimination.

Abbreviations

HIV	Human Immunodeficiency Virus
ART	Antiretroviral therapy
ARV	Antiretroviral
VLS	Viral load suppression
AOR	Adjusted odds ratios
PMTCT	Prevention of mother-to-child transmission
CLHIV	Children living with HIV
SALs	Small area layers
DBS	Dried blood spot
CI	Confidence intervals
CDC	Centers for Disease Control
UTT	Universal test and treat
SADC	Southern African Development Community
WHO	World Health Organization
UNICEF	United Nations Children's Fund
UNAIDS	Joint United Nations Programmes on HIV/AIDS

Supplementary Information

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Supplementary Material 1

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Author contributions
RM and MM conceptualised and drafted the manuscript. RM and MM analysed the data. SJ, LM, IN, LS, KZ, NM, OS, and SM critically revised the manuscript for important intellectual content. All authors contributed to the final version and approval of the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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