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Antiretroviral therapy status and factors associated with ART use among orphaned and vulnerable children (OVC) living with HIV in Namibia

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ABSTRACT

This study assessed the antiretroviral therapy (ART) status and factors associated with ART use among Children and adolescents living with HIV (C/ALHIV) enrolled in the Namibia OVC program. This retrospective cross-sectional secondary analysis study used data collected at enrolment of C/ALHIV participating in the OVC program, implemented by Project HOPE Namibia (PHN) from 1 August 2023. Data were analyzed utilizing IBM Statistical Package for Social Sciences (SPSS) version 29. Among the 4599 participants included in this analysis, 4441 (96.6%) participants were on ART, with a 95% confidence interval (CI) (96.1% – 97.1%). Participants more likely to be on ART were from households with little or no hunger (Crude Odds Ratio (COR) = 2.19, 95% CI (1.40 – 3.43)), from Eenhana (adjusted odds ratio (AOR) = 8.24, 95% CI (2.58 – 26.37)), Engela (AOR = 3.72, 95% CI (1.63 – 8.50)), Okongo (AOR = 5.22, 95% CI (1.22 – 22.38)), Oshakati (AOR = 2.50, 95% CI (1.04 – 6.01)), and Oshikuku (AOR = 3.70, 95% CI (1.18 – 11.55)). In contrast, participants who were less likely to be on ART were aged 0–9 years, never enrolled at a school (COR = 0.26, 95% CI (0.18 – 0.37)), and were diagnosed or presumed to be with TB (AOR = 0.10, 95% CI (0.01 – 0.73)). Additionally, participants from child-headed households, those who were sexually abused or sexually exploited, were less likely to be on ART, COR = 0.02, 95% CI (0.01 – 0.03), COR = 0.04, 95% CI (0.02 – 0.06), and COR = 0.12, 95% CI (0.10 – 0.15), respectively. The findings indicate that integrating food support into HIV programs may enhance ART uptake among C/ALHIV. Strategies should be implemented to improve the enrolment for OVC in educational institutions.

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Introduction

The United Nations seeks to eradicate the HIV/AIDS epidemic as a public health threat by 2030. To attain this objective, 95% of individuals living with HIV (PLHIV) need to be aware of their HIV status, 95% must be undergoing lifesaving antiretroviral therapy (ART), and 95% of those receiving ART must achieve viral suppression (UNAIDS, 2023a). The early initiation of ART mitigates significant immune damage in the initial phase of HIV infection, a critical factor influencing future disease progression (Planchais et al., 2018). In the absence of ART, over 50% of children born with HIV do not survive past their second birthday (Newell et al., 2004). Early initiation of antiretroviral therapy partially restores damage to the gastrointestinal tract and decreases systemic immune activation (Schuetz et al., 2014). Early initiation of ART facilitates CD4 T-cell recovery, thereby decreasing morbidity and mortality rates. Furthermore, early initiation of ART contributes to the prevention of transmission by decreasing plasma viral load (Chen et al., 2018). In 2023, 89% of people living with HIV (PLHIV) across all age groups were receiving antiretroviral therapy (ART), while 86% of children under 15 were also on ART (UNAIDS, 2023b).

Children and adolescents living with HIV (C/ALHIV) encounter several challenges in initiating ART. Challenges include the distance to healthcare facilities, insufficient funds for transportation, and the caregiver's relationship with healthcare providers (Jolly et al., 2018). Additional factors include the frequency of clinic visits (Jolly et al., 2018), the caregiver's educational level, HIV status, place of residence, and marital status (Exavery, Charles, Kuhlik, et al., 2020). C/ALHIV may not disclose their HIV status to caregivers due to concerns about stigma and discrimination (McHenry et al., 2017), potentially hindering their access to ART. Additionally, caregivers may withhold the HIV status of OVC due to concerns about potential stigma from the community (McHenry et al., 2017).

Numerous studies have examined ART uptake among children in sub-Saharan Africa (SSA) (Hlophe et al., 2023; Shanaube et al., 2021), yet limited research has focused on C/ALHIV due to ethical challenges associated with studying this demographic (Kelley et al., 2016). In 2023, Namibia had over 72,000 children aged 0–17 orphaned due to HIV and AIDS (UNAIDS, 2023). About 98% of children aged 0–14 and 100% of women and men aged 15–24 are on ART (PEPFAR, 2023). Research is necessary to identify factors influencing ART uptake among C/ALHIV. This research aimed to assess ART uptake and the associated factors among C/ALHIV participating in the Project HOPE Namibia (PHN)-led OVC program at the initial assessment. The research evidence can inform suitable programming interventions to enhance health outcomes for C/ALHIV.

Methods

Study design

This study is a retrospective cross-sectional secondary analysis of programmatic data collected from C/ALHIV participating in PHN's Namibia DREAMS OVC program implemented from 1 August 2024.

Program intervention and population

This program defines OVC as children who are affected by HIV and AIDS due to their own or their caregivers' HIV status or other socioeconomic vulnerabilities. The OVC program functions as a vital intervention aimed at improving the welfare of children affected by HIV, violence, poverty, and other vulnerabilities. The program employs a structured case management system to identify, assess, and address beneficiaries' needs, facilitating their progression toward independence and graduation from program support. Children prioritized for support include those living with HIV, survivors of violence, particularly sexual violence, children from child-headed households, children with parents or caregivers who are HIV-positive, children of female sex workers, and infants exposed to HIV. Beneficiaries undergo assessment at a minimum of twice per year utilizing standardized instruments. The assessment encompasses critical domains such as health, education, economic stability, safety, and psychosocial well-being. Case plans are formulated according to assessment results. Plans highlight the necessity of addressing significant vulnerabilities, such as insufficient school attendance, food insecurity, exposure to violence, and unfulfilled health needs. Clear benchmarks for improvement and graduation objectives are established. The services provided include health care linkage, educational support, economic strengthening interventions, psychosocial support, and gender-based violence prevention services.

Recruitment and enrolment of C/ALHIV

The Reach PHN program prioritizes recruiting C/ALHIV through collaborative efforts with health facilities (HFs), PEPFAR care and treatment (C&T) partners, and community-based organizations. Recruitment focuses on children and adolescents with perinatal or sexual HIV exposure, particularly those with poor adherence, unsuppressed viral loads, or other vulnerabilities. Using a targeted approach, the program identifies C/ALHIV through home visits, facility referrals, and HIV risk assessments. In collaboration with C&T partners, Reach PHN also ensures comprehensive documentation of HIV-positive households and integrates HIV testing services (HTS) through innovative modalities such as HIV self-testing (HIVST) kits.

Data source

Anonymized data were obtained from the PHN OVC program database. The source document was PHN's child case management booklet. The data collected during the programs included programmatic details, sociodemographic characteristics of participants and caregivers, vulnerability factors, and outcomes associated with the HIV cascade.

Dependent variable

The dependent variable in this study was 'Is the child on ART?' The answers to this question were 'Yes' or 'No'. 'Yes', was assigned code '2' whereas 'No' was assigned to the code '1'.

Independent variables

This study used sixteen independent variables grouped into participants, caregiver characteristics, and vulnerability factors. We chose the variables based on their relevance and significance to ART uptake among OVCLHIV.

Participant and caregiver characteristics

Participants' characteristics included age group, sex, district, and educational enrolment status. Age, collected as a discrete numerical variable during the program, was categorized into age groups '0–9', '10–14', and '15–19'. Sex was classified as 'male' and 'female', while educational enrolment status was categorized as 'Never enrolled', 'Enrolled', and 'Dropout'. Caregivers' characteristics included sex, marital status, educational level, and HIV status. Sex was classified as 'male' and 'female', while the educational level was categorized as 'Dropout', 'Never enrolled', 'High school or below', 'Attending vocational training or tertiary education', and 'Completed vocational training or tertiary education'. Marital status was categorized as 'Married', 'Separated, divorced, or widowed', and 'Single, never married', while the HIV status was categorized as 'Negative', 'Positive', and 'Don't know'.

Vulnerability factors

The vulnerability factors included in this study were the household hunger scale, the living status of biological parents, whether the child lived in a child-headed household, disability status, whether parents or caregivers had a source of income, sexual abuse, sexual exploitation, and TB diagnosis status. All the responses were coded as 'yes' or 'no', except for the living status of biological parents, which was categorized into 'One parent alive', 'Both parents alive', 'Both parents dead', and 'Don't know', and household hunger scale, which was categorized into 'Little or no hunger', 'Moderate', and 'Severe hunger'.

Data quality assurance

The digital system facilitated the automatic generation of BioID (Unique Identifier Code), implemented automated skip rules, and conducted validation checks for variables such as age and sex and constraints for mandatory questions. The digital system minimized transcription errors, thereby improving data completeness and quality. Data quality assurance (DQA) mechanisms included periodic programmatic spot checks, desk reviews, data quality reviews, and field monitoring by district and regional teams to ensure that reported data met minimum quality standards.

Criteria for inclusion in data analysis

From the 19,121 individuals newly recruited into the program between 2018 and 2024, we excluded those who were not in the 0–19 years age group, did not know their HIV status, and were HIV negative. The remaining 4599 participants were included in the data analysis.

Data analysis

Data were exported from DHIS2 to IBM SPSS version 29 for subsequent analysis. Descriptive statistics, including percentages and frequencies, were utilized to analyze nominal and ordinal data. Chi-square tests assessed the relationships between ART uptake and the participants' characteristics, caregivers' characteristics, and vulnerability factors. We analyzed statistically significant characteristics identified through Chi-square tests via bivariate logistic regression to assess the strength of their associations with ART uptake. Characteristics showing statistically significant associations with ART uptake, as indicated by a p-value below 0.05 in binomial logistic regression, were used in multivariable logistic regression to calculate the adjusted odds ratios.

Ethical considerations

The PHN-led OVC program has been approved by the Namibian Ministry of Health and Social Services (MHSS), the Ministry of Education, Arts, and Culture (MoEAC), the Ministry of Gender Equality, Poverty Eradication, and Social Welfare (MGEPESW), and the Ministry of Sport, Youth, and National Service (MSYNS). Enrolment in the OVC program was entirely voluntary. All minors in the program provided assent, and their parents or caregivers granted consent. OVC of legal age completed a consent form. Data were only collected from the participants after informed consent was obtained. PHN implements a comprehensive privacy management framework by mandating that all personnel sign a Non-Disclosure Agreement, safeguarding all collected data. Access to DHIS2 was granted based on defined roles and criteria. Each user was assigned a unique username and password-protected login credentials. De-identified or aggregated data were employed when data sharing was necessary. Approval from an institutional review board was not required for the secondary data analysis due to the utilization of anonymous programmatic data.

Results

Characteristics of participants and caregivers

Most of the 4599 participants included in this analysis were female (n = 2,454; 53.4%) and were enrolled at a school or educational institution (n = 3,867; 84.1%). Almost half of the participants were aged 15–20 years (n = 2,137; 46.5%), and most caregivers were female (n = 3,791; 82.4%). More details are in Table 1.

Vulnerability factors of participants

The most common source of vulnerability among the participants was having parents or caregivers without a source of income (n = 3,019; 65.6%), followed by severe hunger (n = 718; 15.6%). Other sources of vulnerability included having both parents dead (n = 190; 4.1%), sexual abuse (n = 136; 3.0%), and living in child-headed households (n = 134; 2.9%). Few participants reported ever being sexually exploited (n = 134; 2.9%) and disability (n = 101; 2.2%). More details are in Table 2.

Table 1. Frequency distribution of characteristics of participants

Characteristics	Frequency n (%)
Participant's age group (years)	
0 – 9	1,040 (22.6)
10 – 14	1,422 (30.9)
15 – 19	2,137 (46.5)
District	
Eenhana	420 (9.1)
Engela	887 (19.3)
Katima	675 (14.7)
Okahao	147 (3.2)
Okongo	160 (3.5)
Omuthiya	237 (5.2)
Onandjokwe	425 (9.2)
Oshakati	472 (10.3)
Oshikuku	389 (8.5)
Outapi	324 (7.0)
Tsandi	176 (3.8)
Tsumeb	74 (1.6)
Windhoek	213 (4.6)
Participant's educational enrolment status	
Never enrolled	474 (10.3)
Dropout	258 (5.6)
Enrolled	3,867 (84.1)
Participant's sex	
Male	2,145 (46.6)
Female	2,454 (53.4)
Caregiver's sex	
Male	793 (17.3)
Female	3,791 (82.4)
Missing information	15 (0.3)
Caregiver's marital status	
Married	836 (18.2)
Separated, divorced, or widowed	316 (6.9)
Single, never married	1,617 (35.2)
Missing information	1,830 (39.8)
Caregiver's educational level	
Dropout	1,477 (32.1)
Never enrolled	531 (11.5)
High school or below	348 (7.6)
Attending vocational training or tertiary education	12 (0.3)
Completed vocational training or tertiary education	76 (1.7)
Missing information	2,155 (46.9)
Caregiver's HIV status	
Negative	1,007 (21.9)
Positive	1,764 (38.4)
Don't know	6 (0.1)
Missing information/Refused to answer	1,822 (39.6)

Antiretroviral therapy uptake rate among participants

Among the 4599 participants included in this analysis, 4441 (96.6%) participants were on ART, with a 95% confidence interval (CI) (96.1% – 97.1%), while 158 (3.4%) were not, 95% CI (2.9% – 3.9%). Oshikuku had the highest ART uptake rate (98.7%), while Windhoek had the lowest (92.5%). More details are in Table 3.

Table 2. Frequency distribution of vulnerability factors among participants

Characteristics	Frequency n (%)
Household hunger scale	
Little or no hunger	1,866 (40.6)
Moderate hunger	2,015 (43.8)
Severe hunger	718 (15.6)
Are your parents alive?	
Both parents alive	3,099 (67.4)
One parent alive	1,007 (21.9)
Both parents dead	190 (4.1)
Don't know	97 (2.1)
Missing information	206 (4.5)
Is the child living in a child-headed household?	
Yes	134 (2.9)
No	4,465 (97.1)
Do you have any disability?	
Yes	101 (2.2)
No	4,203 (91.4)
Missing	295 (6.4)
Does the parent/caregiver have a source of income?	
Yes	3,019 (65.6)
No	1,307 (28.4)
Missing	273 (5.9)
Have you ever been sexually abused?	
Yes	136 (3.0)
No	4,463 (97.0)
Have you ever been sexually exploited?	
Yes	134 (2.9)
No	4,465 (97.1)
Is the child a presumptive or diagnosed TB case?	
Yes	132 (2.9)
No	4,467 (97.1)

Table 3. Frequency distribution of ART uptake by district among participants

	On ART	
District	No n (%)	Yes n (%)
Eenhana	6 (1.4)	414 (98.6)
Engela	17 (1.9)	870 (98.1)
Katima	43 (6.4)	632 (93.6)
Okahao	6 (4.1)	141 (95.9)
Okongo	3 (1.9)	157 (98.1)
Omuthiya	16 (6.8)	221 (93.2)
Onandjokwe	16 (3.8)	409 (96.2)
Oshakati	14 (3.0)	458 (97.0)
Oshikuku	5 (1.3)	384 (98.7)
Outapi	7 (2.2)	317 (97.8)
Tsandi	4 (2.3)	172 (97.7)
Tsumeb	5 (6.8)	69 (93.2)
Windhoek	16 (7.5)	197 (92.5)
TOTAL	158 (3.4)	4,441 (96.6)

Table 4. Factors associated with ART uptake among participants

Characteristics	Crude Odds ratios	95% CI*	Adjusted** Odds ratios	95% CI*	Chi-square test p-value
Participant's age group (years)					**<0.01**
0 – 9	**0.26**	**0.18 – 0.37**	0.55	0.32 – 0.92	
10 – 14	0.93	0.59 – 1.48	1.30	0.77 – 2.19	
15 – 19	Reference	Reference	Reference	Reference	
Participant's educational enrolment status					**<0.01**
Never enrolled	**0.25**	**0.17 – 0.35**	0.64	0.37 – 1.11	
Dropout	0.75	0.38 – 0.50	0.58	0.26 – 1.28	
Enrolled	Reference	Reference	Reference	Reference	
Sex					0.66
Male	NC	NC	NI	NI	
Female	NC	NC	NI	NI	
District					**<0.01**
Eenhana	**5.60**	**2.16 – 14.54**	**8.24**	**2.58 – 26.37**	
Engela	**4.16**	**2.06 – 8.37**	**3.72**	**1.63 – 8.50**	
Katima	1.19	0.66 – 2.17	0.95	0.46 – 1.94	
Okahao	1.91	0.73 – 5.00	1.01	0.34 – 3.01	
Okongo	**4.25**	**1.22 – 14.85**	**5.22**	**1.22 – 22.38**	
Omuthiya	1.12	0.55 – 2.30	1.03	0.42 – 2.52	
Onandjokwe	**2.08**	**1.02 – 4.24**	1.73	0.73 – 4.11	
Oshakati	**2.66**	**1.27 – 5.55**	**2.50**	**1.04 – 6.01**	
Oshikuku	**6.24**	**2.25 – 17.28**	**3.70**	**1.18 – 11.55**	
Outapi	**3.68**	**1.49 – 9.10**	2.51	0.85 – 7.43	
Tsandi	**3.49**	**1.15 – 10.65**	3.65	0.94 – 14.10	
Tsumeb	1.12	0.40 – 3.17	1.43	0.39 – 5.19	
Windhoek	Reference	Reference	Reference	Reference	
Caregiver's sex					0.80
Male	NC	NC	NI	NI	
Female	NC	NC	NI	NI	
Caregiver's marital status					0.82
Married	NC	NC	NI	NI	
Separated, divorced, or widowed	NC	NC	NI	NI	
Single, never married	NC	NC	NI	NI	
Caregiver's educational level					**0.04**
Dropout	1.08	0.33 – 3.55	NI	NI	
Never enrolled	3.60	0.88 – 14.69	NI	NI	
High school or below	1.55	0.41 – 5.86	NI	NI	
Attending vocational training or tertiary education	2.63	0.95 – 3.24	NI	NI	
Completed vocational training or tertiary education	Reference	Reference	NI	NI	
Caregiver's HIV status					0.19
Negative	NC	NC	NI	NI	
Positive	NC	NC	NI	NI	
Don't know	NC	NC	NI	NI	
Household hunger scale					**<0.01**
Little or no hunger	**2.19**	**1.40 – 3.43**	1.57	0.89 – 2.77	
Moderate hunger	1.31	0.88 – 1.96	1.24	0.76 – 2.00	
Severe hunger	Reference	Reference	Reference	Reference	
Are your biological parents alive?					**<0.01**
One parent alive	1.61	0.36 – 7.24	NI	NI	
Both parents alive	0.53	0.13 – 2.16	NI	NI	
Both parents dead	0.98	0.18 – 5.44	NI	NI	
Don't know	Reference	Reference	Reference	Reference	
Is the child living in a child-headed household?					**<0.01**
Yes	**0.02**	**0.01 – 0.03**	3.46	0.95 – 7.46	
No	Reference	Reference	Reference	Reference	
Do you have any disability?					0.75

(*Continued*)

Table 4. (Continued).

Characteristics	Crude Odds ratios	95% CI*	Adjusted** Odds ratios	95% CI*	Chi-square test p-value
Yes	NC	NC	NI	NI	
No	NC	NC	NI	NI	
Does the parent/caregiver have a source of income?					0.20
Yes	NC	NC	NI	NI	
No	NC	NC	NI	NI	
Have you ever been sexually abused?					**<0.01**
Yes	**0.04**	**0.02 – 0.06**	1.03	0.06 – 2.25	
No	Reference	Reference	Reference	Reference	
Have you ever been sexually exploited?					**<0.01**
Yes	**0.12**	**0.10 – 0.15**	3.65	0.11 – 11.93	
No	Reference	Reference	Reference	Reference	
Is the child a presumptive or diagnosed TB case?					**<0.01**
Yes	**0.08**	**0.05 – 0.13**	**0.10**	**0.01 – 0.73**	
No	Reference	Reference	Reference	Reference	

NC – Not computed; NI – Not included; *CI is the 95% confidence interval; **Adjusted for the district, participant's age group, participant's educational enrolment status, household head status, household hunger scale, sexual abuse, sexual exploitation, and TB diagnosis.

Factors associated with ART uptake among participants

Chi-square tests revealed statistically significant associations between ART uptake and the participant's age group, educational enrolment status, district, caregiver's educational level, and household hunger scale ($p < 0.05$). Furthermore, Chi-square tests also revealed a significant association between ART uptake and the presence of biological parents, living in child-headed households, sexual abuse, sexual exploitation, and whether the child was diagnosed or presumed to have tuberculosis (TB) ($p < 0.05$). However, the participant's and caregiver's sex, the caregiver's source of income, the caregiver's HIV status, and disability were not significantly associated with ART uptake.

Participants from households with little or no hunger were more likely to take ART than those with severe hunger, Crude Odds Ratio (COR) = 2.19, 95% CI (1.40 – 3.43). However, this association was not statistically significant in the adjusted analysis. Furthermore, participants more likely to take ART compared to those in Windhoek were from Eenhana (adjusted odds ratio (AOR) = 8.24, 95% CI (2.58 – 26.37)), Engela (AOR = 3.72, 95% CI (1.63 – 8.50)), Okongo (AOR = 5.22, 95% CI (1.22 – 22.38)), Oshakati (AOR = 2.50, 95% CI (1.04 – 6.01)), and Oshikuku (AOR = 3.70, 95% CI (1.18 – 11.55)). In contrast, participants who exhibited a lower likelihood of ART uptake were aged 0–9 years (COR = 0.26, 95% CI (0.18 – 0.37)), never enrolled at a school (COR = 0.25, 95% CI (0.17 – 0.35)), and were diagnosed or presumed to be with TB (AOR = 0.10, 95% CI (0.01 – 0.73)). Additionally, participants from child-headed households, those who were sexually abused or sexually exploited, had a lower likelihood of taking ART, COR = 0.02, 95% CI (0.01 – 0.03), COR = 0.04, 95% CI (0.02 – 0.06), and COR = 0.12, 95% CI (0.10 – 0.15), respectively. More details are in Table 4.

Discussion

The findings indicated that 96.6% of participants were taking ART. The majority of C/ALHIV caregivers were female. Oshikuku exhibited the highest rate of ART uptake, whereas Windhoek had the lowest rate. C/ALHIV from households experiencing little or no hunger and those from Eenhana, Engela, Okongo, Oshakati, and Oshikuku exhibited a higher likelihood of ART uptake. Conversely, participants with a reduced likelihood of ART uptake were aged 0–9 years, had never been enrolled in school, and were diagnosed or presumed to have TB. Furthermore, individuals from child-headed households and those who experienced sexual abuse or exploitation exhibited a reduced likelihood of ART uptake.

The study found an ART uptake rate of 96.6% among C/ALHIV, surpassing the national average of 89% reported for the country in 2023 (UNAIDS, 2023). This finding can be attributed to the enhanced community-based distribution of ART, which has eliminated financial and healthcare facility barriers previously encountered by C/LHIV (Katirayi et al., 2022). Community-based ART may have contributed to reducing the stigma and discrimination faced by PLHIV, including C/ALHIV (Eshun-Wilson et al., 2021). The findings indicate that the majority of C/ALHIV caregivers were female. One study reported that female-headed households care for more orphans than male-headed households (Thupayagale-Tshweneagae et al., 2010). This finding is attributable to grandmothers being the primary caregivers of orphans left by their children in most African communities (Karimli et al., 2012).

Participants in predominantly rural districts such as Eenhana, Engela, Okongo, Oshakati, and Oshikuku exhibited a higher likelihood of initiating ART than those in Windhoek. This finding may result from the support provided by rural extended families of the orphans, particularly aunts and uncles, who may be aware of their HIV status (Karimli et al., 2012). The extended family concept, eroded by urbanization, might contribute to neglect and the little support orphans receive in urban settings (Ringson & Chereni, 2020). The present study indicated that individuals from households experiencing little or no hunger were more likely to commence ART than those facing severe hunger. Multiple studies reported that food insecurity is a substantial obstacle to ART uptake (Bajunirwe et al., 2018; Fox et al., 2010). Like other PLHIV, C/ALHIV may not commence ART if there is no assurance of a reliable food source, stemming from the perception that antiretroviral medications require food for effective administration (Exavery, Charles, Barankena, et al., 2020). Food insecurity may account for the lower likelihood of ART initiation among C/ALHIV from child-headed households. These findings indicate that incorporating food support into HIV programs may enhance ART uptake among C/ALHIV. Additionally, education regarding ART should be improved for C/ALHIV to ensure they comprehend that ART can be administered on an empty stomach.

The current study revealed that children aged 0–9 years had lower odds of ART uptake than those aged 15–19. This finding contrasts with a study conducted in Tanzania, which found no correlation between age and ART uptake (Exavery, Charles, Kuhlik, et al., 2020). The findings of this study may be attributed to the necessity for younger children to rely on caregivers to obtain their medication at healthcare facilities or community delivery locations. C/ALHIV who were not enrolled in school demonstrated a lower

likelihood of initiating ART than their enrolled counterparts. A potential explanation for this is that individuals who are enrolled possess a greater understanding of ART compared to those who are not enrolled, as HIV and AIDS information is incorporated into educational curricula in schools and colleges. Strategies should be implemented to enhance the enrolment of OVC in educational institutions. C/ALHIV diagnosed or presumed to have TB were less likely to initiate ART, and this may be attributed to the waiting period mandated before commencing ART following the initiation of TB treatment or concerns regarding potential side effects from the concurrent use of both medications.

C/ALHIV who reported a history of sexual abuse or sexual exploitation were less likely to initiate ART. These findings may result from these events' impact on their mental health. These events may result in psychological distress, which may lead to mood disorders and alcohol and substance abuse. Post-traumatic stress resulting from sexual abuse or exploitation can contribute to suicidal ideation (Nguyen et al., 2019). Mental health issues may hinder ART uptake among C/ALHIV, as they may have lost hope in life.

Although the present analysis identified socio-economic and structural vulnerabilities, such as household hunger and low school enrolment, as predictors of ART non-use, these factors likely operate alongside interpersonal and household-level dynamics that could not be captured in this study. Disclosure of HIV status to children and the mediation of care by caregivers or guardians are well-documented determinants of paediatric ART uptake and adherence, particularly among younger children. Caregiver mental health, treatment literacy, stigma, and caregiving capacity may shape whether a child is linked to or maintained in care. Similarly, differences in treatment trajectories between vertically and horizontally infected children, such as timing of diagnosis, prior health-seeking behaviour, and caregiver involvement, may influence ART initiation patterns. Because these dimensions were not available in the dataset, future research using mixed methods, caregiver-child dyadic data, and longitudinal follow-up is needed to unpack the pathways that place a minority of children outside the ART cascade despite high national coverage.

This study has several limitations. First, caregiver-level characteristics, including disclosure practices, treatment literacy, caregiving capacity, and psychosocial factors known to influence paediatric ART initiation, were not collected and could not be analysed. Second, the dataset did not allow differentiation between vertically and horizontally acquired HIV infection, limiting our ability to interpret potential differences in ART uptake trajectories between these groups. Third, because ART non-use was rare (3.5%), findings should be interpreted cautiously and understood as indicative of the vulnerabilities experienced by a small subset of highly marginalised children. Future studies should incorporate caregiver data, qualitative enquiry, and longitudinal designs to enable a deeper understanding of the mechanisms underlying ART non-initiation or delayed initiation among children living with HIV. Fourth, while this study provided important information on ART adherence and related factors among C/ALHIV, it could not provide information related to ART adherence, which is a significant factor in the health-related outcomes of C/ALHIV. A future study is necessary to determine the rate of ART adherence and associated factors among C/ALHIV in Namibia. Finally, the study could not factor out the impact of previous or concurrently running programs on ART uptake in the current program.

A qualitative study is necessary to investigate these reasons. This study's results may be influenced by social desirability bias due to the self-reported nature of the data. Additionally, causal inferences cannot be drawn from the results due to the study's cross-sectional nature.

Conclusion

The early initiation of ART mitigates significant immune damage in the initial phase of HIV infection, a factor critical for influencing future disease progression. In 2023, only 86% of children under 15 were receiving ART. C/ALHIV encounter multiple obstacles in the initiation of ART. The study revealed that 96.6% of participants were taking ART. Participants demonstrating a reduced likelihood of ART uptake included those aged 0–9 years, individuals who had never been enrolled in school, and those diagnosed or presumed to have TB. Furthermore, individuals from child-headed households and those who experienced sexual abuse or exploitation exhibited a reduced likelihood of ART. These findings support the inclusion of food support into HIV programs to increase ART uptake, enrolment in schools, and ART education among C/ALHIV.

Author contributions

CRediT: **Enos Moyo:** Conceptualization, Formal analysis, Writing – original draft; **Hadrian Mangwana:** Data curation, Writing – review & editing; **Endalkachew Melese:** Conceptualization, Writing – review & editing; **Simon Takawira:** Data curation, Writing – review & editing; **Bernadette Harases:** Writing – review & editing; **Rosalia Indongo:** Writing – review & editing; **Perseverance Moyo:** Writing – review & editing; **Ntombizodwa Makurira Nyoni:** Writing – review & editing; **Tafadzwa Dzinamarira:** Writing – original draft, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Enos Moyo is a seasoned HIV/public health specialist and health economist with over two decades of experience in HIV management and applied health research. He holds multiple advanced degrees, including a PhD in Public Health Medicine, an MPH, an MBA, an MPhil in HIV/AIDS Management, and an MSc in Applied Health Economics. Dr. Moyo has published over 90 peer-reviewed scientific articles and serves as a section and guest editor for several leading international journals. He has received recognition for his data-driven leadership, mentoring of young professionals, and contributions to health equity and system strengthening in Southern Africa. His research topics mainly include HIV/AIDS, maternal and child health, infectious diseases, cost-effectiveness analysis, pre-exposure prophylaxis, adolescent girls and young women, and key populations.

Hadrian Mangwana is a medical doctor and public health specialist with extensive experience leading large-scale HIV and OVC programs in Namibia. With a background in medicine and a Master's degree in Epidemiology, he has spent more than a decade working at the intersection of health systems strengthening, HIV response, community program design, and vulnerable child

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Endalkachew Melese is an internal medicine physician with more than twenty years of progressive experience in health care across resource-limited settings. He brings extensive expertise in infectious diseases along with broad experience in adolescent and youth health, health systems strengthening, and evidence-based program implementation. Recognized as a skilled program manager, mentor, clinician, and academician, Dr. Melese currently serves as Senior Technical Director for the PEPFAR USAID/Namibia-funded REACH 1 (Reducing HIV Vulnerability: Integrated Child and Youth Health) Activity. In this capacity, he leads strategic initiatives to prevent new HIV infections among adolescent girls and young women. He oversees a comprehensive package of interventions, including HIV and violence-prevention education, HIV testing services, pre-exposure prophylaxis, youth-friendly sexual and reproductive health care, post-violence support, and economic strengthening interventions. Dr. Melese collaborates closely with Namibian government ministries, PEPFAR Namibia, development partners, the private sector, and community leaders to ensure local ownership and sustainability. He also leads business development and provides technical expertise for infectious disease programs across sub-Saharan Africa through Project HOPE—The People-to-People Health Foundation, Inc. and Project HOPE Namibia, reinforcing his longstanding commitment to improving public health outcomes.

Simon Takawira is an accomplished monitoring, evaluation, research, and learning specialist with over 13 years of experience advancing evidence-driven health and development programs across Southern Africa. He has held senior roles with Project HOPE, FHI360, PSI, SAfAIDS, UNESCO, and Johns Hopkins CCP, where he led multi-country MEL systems for HIV, adolescent and pediatric health, SRHR, and health systems strengthening. Simon's expertise spans quantitative and qualitative research design, mixed-methods analysis, and evaluation management. He has developed research protocols, supervised data collection for large-scale surveys, conducted thematic and statistical analysis using NVivo, Stata, SPSS, and R, and contributed to peer-reviewed publications and technical reports. His work has generated insights that shaped policy dialogue, program redesign, and investment decisions for government and funding partners. A strong advocate for knowledge management, Simon has designed learning agendas, facilitated after-action reviews, built digital knowledge repositories, and produced synthesis briefs, dashboards, and evidence products to support organizational learning. He is recognized for his ability to translate complex data into accessible, actionable insights and for strengthening the capacity of health workers, community partners, and government teams.

Bernadette Harases is an accomplished social worker with extensive experience. She is currently the program director of the DREAMS and OVC programs at Project HOPE Namibia. Bernadette has supported government and implementing partners to expand evidence-based interventions for children and adolescents living with HIV, survivors of violence, and households facing health and socio-economic vulnerabilities. Her work emphasizes quality improvement, program integration, and linking community systems with clinical services to strengthen continuity of care. She has led the implementation of multi-regional OVC and DREAMS programs under USAID/PEPFAR funding mechanisms, ensuring alignment with national policies, donor compliance standards, and results-driven approaches.

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Perseverance Moyo is an experienced registered nurse with over two decades of working with HIV patients in sub-Saharan Africa. She holds multiple advanced degrees, including an MBA and an MSc in Nursing Education. She has published over 30 peer-reviewed scientific articles. Her research topics include HIV/AIDS, maternal and child health, infectious diseases, pre-exposure prophylaxis, adolescent girls and young women, and key populations. She currently works as a Nurse Manager and Clinical mentor.

Ntombizodzwa Makurira Nyoni is a public health researcher and scientific writer with more than fifteen years of experience leading HIV prevention, implementation science, and community-led monitoring initiatives in Namibia and the broader Southern African region. Her work focuses on generating and translating evidence to strengthen national HIV programmes, with expertise in mixed-methods research, qualitative synthesis, and cost-effectiveness evaluation. She has provided scientific and editorial leadership for multi-partner studies supported by MoHSS, UNAIDS, PEPFAR/CDC, UCSF, and Global Fund, producing manuscripts, technical briefs, and donor reports that inform policy and programme adaptation. Her portfolio includes research on PrEP uptake among adolescent girls and young women, social harms and benefits of new HIV testing models, key population risk mapping, and community insights into treatment literacy. Currently, Ms. Nyoni is pursuing her PHD at UKZN and is a Programs Coordinator and Head of Technical team at the Society for Family Health Namibia, where she advances knowledge translation, research uptake, and evidence-driven decision-making across national HIV programme.

Tafadzwa Dzinamarira is ICAP's country director in Zambia. He is a public health expert with a solid clinical and epidemiological research background. He has over seven years of experience providing technical support for public health systems and clinical laboratories, strengthening the management of HIV/AIDS programs. Dr. Dzinamarira has expertise in providing technical leadership in developing, developing, planning, and implementing national household-based biomarker surveys. He holds a Master of Science in HIV/AIDS Management, a Master of Public Health (Disease Prevention and Control), and a Doctor of Philosophy in Public Health Medicine. Before this role, Dr. Dzinamarira was the Country Director for ICAP in Zimbabwe. Before that, he was the Regional Laboratory Technical Advisor for the PHIA project, where he successfully supported the implementation of national HIV impact assessment surveys in Namibia, Rwanda, Haiti, Eswatini, Lesotho, Malawi, Mozambique, Uganda, Tanzania, and Zimbabwe. Before joining ICAP, Dr. Dzinamarira worked for the University of Zimbabwe Department of Medicine on a prospective operation research series aimed at decreasing mortality by initiating antiretroviral therapy in Africa through early detection and prevention of cryptococcal disease in Zimbabwe.

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