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Factors associated with failure to initiate ART amongst youth aged 15-24 years inSouth Africa: A secondary analysis

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FACULTY OF HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH

FACTORS ASSOCIATED WITH FAILURE TO INITIATE ART AMONGST YOUTH AGED 15-24 YEARS IN SOUTH AFRICA: A SECONDARY ANALYSIS

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of MSc in Epidemiology (Biostatistics)

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Declaration

I, Goitseone Maseko, hereby declare that this research report is my own work. It is being submitted for the Degree of Master of Science in Epidemiology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature: 

Date: 27 December 2024

Dedication

This research report is dedicated to the Lord Almighty who has given me this opportunity and guided me in my footsteps. To my mother and late father for their love and presence in my life.

Acknowledgement

I would like to thank my supervisor and co supervisor Professor Jonathan Levin and Professor Khangelani Zuma for their guidance and mentorship during this process. Thank you for giving me the push I needed to complete the report.

To my family, my husband, children, mother and siblings for their love, patience, support and encouragement.

Thank you to the Human Sciences Research Council (HSRC) for providing me with the data needed for the study.

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Abstract

Background

Antiretroviral therapy (ART) is made available to anyone living with HIV. Despite this, young people in Southern Africa experience poor ART outcomes compared to adults. In order to meet the 95-95-95 target for 2030, effective ART use is an important component. The aim of this study is to determine the proportion of HIV-infected youth aged 15-24 who are not on ART, the factors associated with not being on ART and the spatial distribution of ART non-use amongst this population.

Methodology

This study is a secondary analysis of a cross-sectional, population-based household survey conducted in 2017. The target population consisted of participants aged 15-24 years who completed individual interviews and provided blood samples which were tested for HIV. The outcome of the study was ART non-use based on negative test results of antiretroviral drugs from the HIV positive samples. Non-spatial (univariable and multivariable) logistic regression models as well as spatial logistic regression models were fitted

Results

The majority (59.2%) of the participants were not on ART. Most of the results for non-spatial and spatial logistic regression were similar. The odds of ART non-use were higher among those who tested for HIV more than a year ago compared to those who tested less than a year ago. The odds of ART non-use were statistically lower among participants from rural areas compared to those from urban areas.

Conclusion

The study highlighted the need for HIV testing and knowing one's status. More interventions should be aimed at young people who are students/employed as well as those residing in urban areas. More attention is still needed for females where the odds of ART non-use were higher. Young people also need to understand the need

to delay sexual activity at a young age and practice safe sexual behaviour when they become sexually active.

Keywords: HIV, ARV, testing, adolescent, young people

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List of abbreviations

Abbreviation	Definition
AIC	Akaike Information Criterion
AIDS	Acquired Immune Deficiency Syndrome
ALHIV	Adolescents Living With HIV
AOR	Adjusted Odds Ratio
ART	Antiretroviral therapy
ARV	Antiretroviral drug
AYA	Adolescents And Young Adults
BIC	Bayesian Information Criterion
CDC	Center for Disease Control and Prevention
DBS	Dry Blood Spot
DREAMS	Determined, Resilient, Empowered, AIDS-free, Mentored and Safe
HAART	Highly Active Antiretroviral Treatment
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
LMIC	Low And Middle-Income Country
MET	Motivational Enhancement Therapy
MLE	Maximum Likelihood Estimator
OR	Odds Ratio
PLHIV	People Living with HIV
PSU	Primary Sampling Unit
REC	Research Ethics Committee
SABSSM	South Africa National HIV Prevalence, Incidence, Behaviour, and Communication Survey
SAL	Small Area Layer
SMS	Short Message Service
UNAIDS	United Nation's programme on HIV/AIDS
VP	Visiting Point
WHO	World Health Organisation

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Chapter 1: Introduction

1.1 Background

At the end of 2021, 38.4 million people were reported to be living with HIV (1); 36.0 million of these individuals were adults over the age of 15 (1); 6.1 million individuals living with HIV did not know that they were indeed living with HIV and 680 000 people worldwide died from AIDS-related illnesses in 2020, compared to the 1.9 million people who died in 2004 and 1.3 million in 2010 (1,2).

WHO (World Health Organisation) released guidelines in 2015 on who would be eligible for starting ART and by 2016 many countries in Africa had implemented the guidelines (3). Clinical trials confirmed findings that early and regular use of ART kept people living with HIV (PLHIV) healthier and reduced transmission to partners (3). As of 2020, AIDS-related deaths were reported to be reduced by 64% since the peak in 2004 (4). It was reported in 2020 that since 2010 there has been a 39% decline in AIDS-related mortality (4).

While there was a decline in the number of new infections, countries based in Southern Africa continued to be the epicentre of the epidemic (5). South Africa was reported to have the largest HIV epidemic in the world with an estimated 7.7 million PLHIV in 2018 (6) and the number has increased to 8.45 million in 2022 (12). As a result, the WHO African region introduced some strategies to ensure that countries reached targets for universal access to HIV prevention, treatment, care, and support (4). The targets were set for 2015 using the 2009 data as a baseline. They aimed to decrease by 50% the percentage of infected young people aged 15-24 years and to decrease the number of HIV-related deaths by 25% (4). The increase in access to ART has led to a decline in HIV incidence and mortality in the African region (5).

The United Nation's programme on HIV/AIDS (UNAIDS) introduced the "90-90-90" 2020 target in 2013. The target indicated that by 2020, "90% of people living with HIV/ who are infected by HIV should be diagnosed, 90% of those diagnosed

individuals should be on ART and 90% of those individuals on ART should have achieved viral suppression" (8). The target was made as an effort to end the AIDS epidemic by 2030. According to the UNAIDS 2018 report, in the Eastern and Southern Africa region, 81% of PLHIV were diagnosed, 66% of them knew their status and were on ART and 52% of those on treatment had their viral load suppressed (9). By the end of 2020, eight countries had met the target and on average the countries in Eastern and Southern Africa met the target (10). Globally, the target was missed only by a small percentage, "84% of PLHIV knew their status, 87% of PLHIV who knew their status were accessing ART, and 90% of people on ART were virally suppressed" (10).

The current "95-95-95" 2025 target now applies. This target has indicated that by 2025, "95% of people living with HIV who are infected with HIV should be diagnosed, 95% of those diagnosed individuals should be on ART and 95% of those individuals on ART should have achieved viral suppression" (11). In 2021, 75% of the 28.7 million PLHIV received ART; the number increased by 1.5 million people from 2020 (12) . For the 2025 target to be reached, which is 35 million people on ART, there should be an increase of 1.3 million people on ART each year (12) . Progress towards the target indicates that globally by 2021, "85% of PLHIV knew their status, 75% of PLHIV who knew their status were accessing ART, and 68% of people on ART were virally suppressed" (12).

1.2 Literature review

1.2.1 ART use among young people

Adherence to highly active antiretroviral treatment (HAART) was determined among HIV-infected individuals aged 15 years and above in a study from Kenya (13). Findings indicate that individuals aged 20-24 were found to be less likely to adhere to medication in comparison to the older participants and fear of their HIV status being disclosed was the main reason behind it (13).

A cross-sectional study, carried out by the HIV research network in the United States, on youth aged 15-24 years who were in the process of transitioning to adult clinics, released findings that young people who acquired HIV perinatally faced challenges when it comes to transitioning to the adult HIV clinics (14) . The youth indicated that the adult clinics tend to be more intimidating especially since they were used to the more youth-friendly services received from the adolescent HIV clinics (14). A study conducted in Nigeria found that older adolescents (aged 16-17.9 years) who were infected with HIV perinatally, dropped out of care when they transitioned from the child-centred ART care to the adult-centred ART care (15).

A qualitative study on youth aged 15-25 years from Soweto, South Africa reported findings from participants who acquired HIV vertically (65% of the participants) (16) . They reported that even though they had the correct knowledge on adherence and understood the consequences of non-adherence, they still faced some difficulties with adherence (16). Some indicated that they still struggled with the size, smell and taste of the pills and this made it harder for them to continue taking them, so they tended not to be consistent (16).

A study investigated transitioning for adolescents and youth aged less than 16 years old and followed up until 22 years from international databases (17). The study indicated that there was a decline in retention in care once the transition ages (16,

18, 20 and 22) were reached and that gaps in care prior to transitioning ages would result in worse adherence outcomes (17).

1.2.2 Factors associated with the lack of ART use

A study in Nepal carried out among individuals with ages ranging from 18-62, found that those who had not disclosed their HIV status to anyone else besides the health care worker and those who drank alcohol were less likely to adhere to ART (18). A study in the United States sought to understand whether several factors may have an impact on whether adolescents and young adults (13-24 years old) use ART (19). The findings indicate that living in disadvantaged areas with high rates of unemployment were associated with a higher proportion of HIV-infected young adults not being on ART (19).

A study on non-adherence was carried out among adolescents living with HIV (ALHIV) aged 12-19 years from Malawi (20). They found that 39% of non-adherence was attributed to forgetting to take medication, 14% to difficulty in travelling from home to collect the medication, 11% to being busy with other things with 6% feeling depressed/ overwhelmed while 8% felt stigmatised (20).

A qualitative study carried out in Soweto, aimed to understand knowledge and experiences among adolescents relating to ART adherence (16). Findings indicate that individuals aged 15–25 years experienced adherence challenges related amongst other reasons, to consuming alcohol with medication and fear that their HIV status would be exposed as a result of taking pills in public (16). A study in Kenya which focussed on individuals aged 15 years and above, attributed failure to adhere to ART to a lack of family support and poverty (13).

1.2.3 Interventions aimed at improving ART use among young people

Several interventions have been implemented in order to improve ART adherence amongst young people. A systematic review conducted on studies carried out among

adolescents and young adults (AYA) aged 10-19 aimed to assess interventions to improve adherence among AYA from low and middle-income countries (LMICs) (19). The review determined that a number of factors have an impact on adherence amongst AYA and these factors were divided into three categories: patient-level factors (socio-economic factors, stigma), health services factors (drug availability, clinic waiting times) as well as medication factors (dosage, side effects) (19).

A review looked at ART adherence and intervention studies that aimed to improve adherence among HIV-infected individuals aged 13-24 years. Findings indicate that some of the strategies for improving adherence include peer support, telephone follow-up reminders, and self-monitoring, since a reason given for not adhering was that participants had just forgotten to take their medication, so they did not intentionally decide not to take medication that benefitted their health (21). This study also tested whether attending an adolescent-friendly clinic had any impact on their viral load suppression; the results indicate that attending such a facility led to a great improvement in their viral load suppression, and this was attributed to the adolescent-friendly environment on ART compared to non-orphans. Having a mother as a primary caregiver was indicated as a reason why 12–17-year-olds were more adherent (22).

A qualitative study in Uganda aimed to address the problem of failure to adhere to antiretroviral treatment by conducting a focus group discussion where HIV-positive young people aged 15-24 years old were introduced to the short message service (SMS) with coded texts to remind the youth when to take their antiretroviral treatments as a form of intervention. The youth asked that the texts should be coded so that their HIV status would not be revealed (22). Some suggested strategies for improving adherence include having treatment regimens that minimize side effects, motivational enhancement therapy (MET) for those in denial of their HIV status which negatively impacts adherence, health literacy support programs as well as dedicated youth clinics to improve health staff friendliness (23).

1.2.4 Spatial clustering in HIV studies and ART non-use

Disease mapping which describes the spatial distribution of a disease is important in understanding the epidemiology of the disease. The spatial distribution of a disease describes how the estimate of a disease outcome in a certain location is related to the estimate of the same outcome when it is measured at a nearby location (24). The focus is also made on the relationship between the health outcome and a range of predictors. Modelling of disease allows for certain variations of the risk of the disease outcome to be included (24).

A study that aimed to identify risk factors that are associated with HIV infection in people aged 15-24 years from Uganda through logistic regression and spatial analysis determined that there was a significant association between some of the demographic and behavioural variables. It was also noted that spatial effects, obtained through the Bayesian framework, have greatly influenced the distribution of HIV infection in Uganda (3).

A study in Malawi modelled predictors of HIV prevalence using logistic regression and spatial mapping using data for adults aged 15 years or older from the 2015-2016 Malawi Demographic and Health Survey (25). Socio-demographic individual characteristics as well as household characteristics, were used as explanatory variables. Results showed variability of HIV prevalence at regional and sub-regional levels, with the Southern region having the highest prevalence (25). Results from this study in Malawi confirmed the importance of spatial analysis when designing effective HIV prevention and treatment strategies.

1.3 Problem statement

Statistics South Africa (Stats SA) released a report in 2018 stating that South Africa has 7.52 million individuals infected with HIV, which is 13.1% of the total population (14). A study that examined the distribution of HIV infection and AIDS in sub-Saharan Africa reported that South Africa has 25% of PLHIV in sub-Saharan Africa, while other countries in the region have less than 10% each (15). The majority of the South African population is made up of young people and this group is important because not only does HIV prevalence in the youth affect the demographic future of the country, but it also has an influence on the future behaviours of young adults.

1.4 Justification

The UNAIDS 2019 report on progress towards the achievement of the 90-90-90 target, released findings for South Africa saying that 90% of PLHIV know their status, 68% of them are on treatment and 87% of those living with HIV and who are on treatment have their viral load suppressed (14). These results showed that South Africa like many countries was still far from reaching the target proportion of PLHIV who are on treatment. In the 2016 UNAIDS report, it was stated South Africa had the highest number of HIV infections among young people (15-24 years) worldwide which accounted for nearly 18% of global infections for this age group (16). The report notes that there were 9.9 new infections per 1000 adults, and 37% of these new infections were in the 15-24 years age group.

1.5 Research question

What are the factors that are associated with ART non-use among HIV-infected youth aged 15–24 years and what is the spatial distribution of ART non-use amongst this population?

1.6 Research aim

To determine the proportion of HIV-infected youth aged 15-24 who are not on ART, the factors associated with not being on ART and the spatial distribution of ART non-use amongst this population.

1.7 Research objectives

The specific objectives of the study are:

1. To determine the proportion of HIV-infected youth aged 15-24 in South Africa who are not on ART.
2. To identify the factors associated with lack of ART use among HIV-infected youth aged 15-24 in South Africa.
3. To determine the spatial variation in lack of ART coverage among HIV-infected youth aged 15-24 in South Africa, adjusted for other factors associated with the outcome.

Chapter 2: Methodology

2.1 Description of the primary study

2.1.1 Study design

A cross-sectional, population-based household survey entitled 'The South African National HIV Prevalence, Incidence, Behaviour and Communication Survey (SABSSM)' was conducted by the Human Sciences Research Council (HSRC). The survey which took place in 2017 was the fifth wave of the study as previous ones were conducted in 2002, 2005, 2008, and 2012. The study aimed to monitor HIV prevalence and incidence over the years and determine the behaviours associated with the infection, as a result, it is appropriate to answer the research question.

2.1.2 Study setting

The primary study took place in households of 9 provinces in South Africa namely Eastern Cape, Western Cape, Northern Cape, Free State, North West, Mpumalanga, Gauteng KwaZulu Natal, and Limpopo. **Study population**: All individuals in sampled households and hostels in South Africa took part in the primary study. According to the primary study, a household was defined as a group of people living together and sharing resources; hostels were used as male-only accommodation during apartheid but have now been converted into family residences.

2.1.3 Sampling methods

A multi-stage stratified random cluster sampling approach was undertaken where over 1000 Small Area Layers (SALs) were sampled across the 9 provinces of SA according to Statistics South Africa sampling frame and 15 visiting points (VPs) in each sampled SAL were sampled which included households in the primary study (26). SALs are detailed geographic areas made up of enumerated areas which are based on population threshold, the area size and land use type (27). A VP was described as a dwelling that may be composed of one or many households (26). The selected SALs were stratified by province, locality type, and race and they constitute the primary sampling units (PSUs) (26).

Oversampling was done in areas where mainly Indians, coloured or white populations resided by adding 13 additional districts (26). The information on the PSUs was obtained from Stats SA. The survey was stratified by province and sampling weights were calculated. This sampling procedure resulted in the primary data set. Individual weights were benchmarked against the 2017 mid-year population estimates demographics and HIV testing information and they were adjusted for HIV non-response (26). The final weights were calculated based on individual questionnaire completion as well as blood specimen collected after the interviews (26). In this analysis, we used the weights for individuals who had a blood specimen collected.

Questionnaires : A digital data-capturing software package CSPro was used to capture one on one interviews in the primary study (26). Four questionnaires were used to collect data, a household questionnaire, and 3 individual questionnaires according to the different ages of participants. The household questionnaires were completed in the selected VPs in which a list of individuals residing in the household was provided. A household was defined as a group of people living together and sharing resources (26).

Eligibility for individual interviews was based on whether they had slept in the household on the night prior to the survey and whether they usually lived in that household at least 5 days a week (26). Eligible individuals were asked to take part in individual interviews. Interviews for children aged 0-11 were provided by the parents/ guardians whereas those aged 12 years and above were interviewed themselves. Individual written or verbal consent was provided by participants for interviews and collection of blood samples. Parental/guardian consent was provided for individuals aged 12-17 years while the individuals (12–17 years old) provided assent for interviews and blood samples (26).

Blood sample collection and testing: Dry blood spots (DBS) were collected from participants who consented, and the collection was conducted by finger prick (for infants, a heel or toe was pricked) (26). Three HIV enzyme immunoassays were

carried out to test and confirm positive results for the HIV antibody. High-performance liquid chromatography was used to determine the presence of ARVs in positive HIV samples and it was conducted through a validated method for the detection of Nevirapine, Efavirenz, Lopinavir, Atazanavir and Darunavir (28). The detection limit set for each drug was at 0.02 µg/ml with a signal-to-noise ratio of at least 5:1 for all the drugs (28). The presence of ARVs (ARV positive results) was determined by positive results from at least one of the drugs listed above. If a sample gave negative results for all the drugs, then the participant was classified as not being on ART (26,28).

2.2 Study design and target population

The secondary analysis was carried out on a cross-sectional study data. Only youth aged 15-24 years who tested positive for HIV were included in this study.

2.3 Study sample

From the over 15 000 targeted VPs in the primary study, 18 351 households were approached and from the valid households, 14 630 households were interviewed. Among individuals that were eligible, 62 011 participated in the study, 11 373 of those participants were aged 15-24 years; and 8117 of the interviewed 15-24 years old participants provided a blood specimen. The flow diagram below describes the number of participants at each stage.

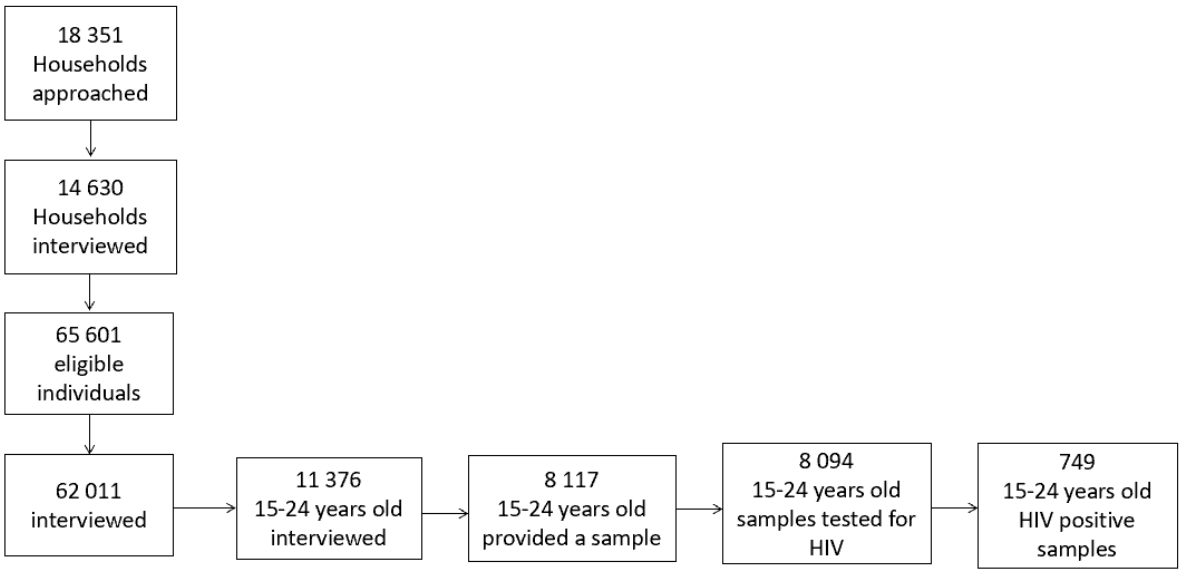


Figure 2.1 Flow diagram of the target population

2.4 Data collection

Data were extracted from the HSRC website (http://curation.hsrc.ac.za/doi-10.14749-1585345902). The data were accessible upon request through a data request form from the HSRC website after indicating that they will be used for scientific research or educational purposes. Upon completion of the form, the requestor would then be given access to download the data.

2.5 Data management

This study carried out a secondary data analysis and was restricted to individuals aged 15-24 years old who consented to provide a blood specimen and tested positive for HIV.

Outcome variable

The outcome variable for this study was not initiating ART among HIV-infected individuals, the value of 1 for those who were not on ART and 0 for those who were on ART was determined by carrying out tests for the presence of a number of ARV drugs using the blood samples, as described above.

Exposure variables

Age was a continuous variable measured in years, it was then divided into two categories, 15-19 and 20-24 years. The categories represent late adolescents and young adults. Sex was categorised into males and females. For this analysis, race was categorised and recoded into African and other (coloured, Indian, and white), this was done as a result of low counts from other racial categories. All the nine provinces in South Africa were included, namely, Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu Natal, North West, Gauteng, Mpumalanga, and Limpopo. Geographical location was categorized into urban and rural areas, rural informal/tribal areas, and rural areas/ farms were recoded into rural areas as a result of low counts.

The highest level of education was categorised into primary (grade 1-grade 9), secondary (grade 10- grade 12), and higher education (further studies incomplete, completed a diploma/ other degrees or other post-school). Employment status was categorised into employed, unemployed (including individuals who are sick/disabled and unable to work), and student. Orphanhood status was categorised into orphans and non-orphans.

Ever had sexual intercourse was categorised into yes and no. The number of sexual partners in the last 12 months was categorised into one sexual partner, two or more sexual partners and no sexual partners. Condom use at the last sexual intercourse was categorised into yes, no and not applicable. Recent HIV test was categorised into less than 12 months, more than a year ago and never tested. Awareness of HIV status was categorised into yes, no and no response. First having sexual intercourse before age 15 was categorised into yes and no.

2.6 Statistical analysis

Stata 15 software was used for descriptive, logistic and spatial regression analysis. R software version 4.3.2 was used to create the map and determine the Moran I.

2.6.1 Objective 1 - Descriptive analysis

The number of participants aged 15–24 years that took part in the study, provided a blood specimen that tested positive for HIV, and tested for the presence of ART was determined. The demographic information of those participants as well as behavioural characteristics were also measured. The Rao-Scott correction was used to test whether associations were statistically significant using the 5% significance level (i.e. $P<0.05$).

2.7.1 Objective 2 - Univariate logistic regression

A logistic regression which models the possibility of an outcome based on several individual characteristics was used. The ART variable was recoded such that the absence of ART would be the focus of the model (0 - the presence of ART, 1 - the absence of ART). Unadjusted logistic models were fitted for each exposure variable. Univariate logistic regression was performed to determine the relationship between the independent exposure variables (behavioural characteristics and the outcome variable).

2.7.2 Objective 2 - Multivariable logistic regression

The initial model included all the exposure variables whether they were statistically significant or not in the univariate logistic regression. Using AIC and BIC values, the final model was selected.

The model fitted is described by the equation below:

$$logit\,[\pi(X)] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p \qquad \text{Equation 1}$$

Where:

π = the probability of not being on ART

β_0 = the intercept

β_i = the regression coefficient

Model selection

The Akaike Information Criterion (AIC) was used to select the final model in logistic regression. The model with the smallest value of the AIC was selected. The Bayesian Information Criterion (BIC) was also considered when the value of the AIC was the same in two or more models

2.7.3 Objective 3 - Spatial analysis

The polygon shapefile data consisting of the South African provincial data was downloaded from the DIVA shapefile site (https://www.diva-gis.org/gdata). The shapefile and final dataset were used for overall spatial analysis.

2.7.4 Spatial logistic regression

A spatial logistic regression model was fitted using R version 4.2.2. The variables used were from the final model fitted in objective 2. The ever-had sexual intercourse variable was removed from the model as it caused multicollinearity.

2.8 Ethical considerations

Ethical approval to conduct this secondary research was obtained from the University of the Witwatersrand (Ethics certificate number: M210662). The primary study was approved by the HSRC Research Ethics Committee (REC: 4/18/11/15) and by the Centers for Disease Control and Prevention (CDC). Access to the data is made available by visiting the HSRC website (http://curation.hsrc.ac.za/doi-10.14749-1585345902) and completing a data request form.

Chapter 3: Results

3.1 Demographic and behavioural characteristics of youth aged 15-24 years

Among the participants aged 15-24 years who were interviewed and provided a blood sample, 749 samples tested positive for HIV. The presence of ART was tested in only 640 samples as a result of sufficient DBS collected in those samples. The remaining 149 samples had insufficient spots to test for the ARVs. Table 1 describes the demographic characteristics of the study participants. Over half of the participants, 59.2% were not on ART. ART non-use was high among participants aged 20-24 years (61.4%), females (60.0%) and Black Africans (59.7%). ART non-use was higher among individuals from urban areas (66.3) and those who were employed (76.1%).

Table 3.1 Demographic characteristics of the study participants by ART exposure

Factor	Level	ART negative % (95% CI)	ART exposed % (95% CI)	n	p-value
Overall		59.2 (52.5-65.5)	40.9 (34.5-47.5)	640	
Age in years	15-19	53.4 (42.9-63.6)	46.6 (36.4-57.1)	200	0.228
	20-24	61.4 (53.3-69.0)	38.6 (31.0-46.7)	440	
Sex	Male	57.0 (45.1-68.1)	43.0 (31.9-54.9)	149	0.662
	Female	60.0 (52.1-67.4)	40.0 (32.6-47.9)	491	
Race	Black African	59.7 (52.7-66.4)	40.3 (33.6-47.3)	549	0.508
	Other	52 (30.8-72.5)	48 (27.5-69.2)	37	
Geographical location	Urban areas	66.3 (58.0-73.7)	33.7 (26.3-42.0)	278	0.027**
	Rural areas	50.5 (39.3-61.8)	49.5 (38.2-60.7)	362	
Highest level of education	Primary	61.8 (48.0-73.9)	38.2 (26.1-52.0)	89	0.995
	Secondary	61.8 (52.4-70.5)	38.2 (29.5-47.6)	251	
	Higher education	60.2 (31.0-83.6)	39.8 (16.4-69.0)	21*	
Employment status	Employed	76.1 (59.7-87.2)	23.9 (12.8-40.3)	61	0.028**
	Unemployed	59.4 (51.8-66.5)	40.6 (33.5-48.2)	359	
	Student	49.4 (38.3-60.4)	50.6 (39.6-61.7)	176	
15-19 years old					
Orphanhood status	Orphan	55.0 (41.3-67.9)	45.0 (32.1-58.7)	108	0.937
	Not orphan	54.3 (41.8-66.2)	45.7 (33.8-58.2)	136	

*****Small sample of less than 30 respondents

**p-value<0.05

3.2 Association between behavioural characteristics and lack of ART use

In the behavioural characteristics from table 3.2, ART non-use was highest amongst 62.3% of participants who ever had sexual intercourse, 87.1% who had their sexual debut when they were younger than 15, 63.9% who indicated that they had one sexual partner in the last 12 months and 87.1% of those who had their sexual debut before the age of 15, had a higher percentage of ART non-use. ART non-use was also higher among individuals who had not used a condom at the last sexual encounter (67.5%), had tested for HIV more than a year ago (67.9%) and those who were not aware of their HIV status (78.2%).

Table 3.2 Behavioural characteristics of the study participants by ART exposure

Factor	Level	ART negative % (95% CI)	ART exposed % (95% CI)	N	p-value
Ever had sexual intercourse	Yes	62.3 (55.2-68.8)	37.7 (31.2-44.8)	444	0.030**
	No	47.0 (35.6-58.7)	53.0 (41.3-64.4)	152	
Age at sexual debut	Younger than 15	87.1 (70.7-95.0)	12.9 (5.0-29.3)	40	0.001**
	15 years and older	56.9 (51.5-66.0)	43.1 (34.0-48.5)	600	
Number of sexual partners in the last 12 months	One partner	63.9 (55.5-71.6)	36.1 (28.4-44.5)	316	0.309
	Two and more partners	61.7 (38.9-80.3)	38.3 (19.7-61.1)	34	
	No partners	54.1 (42.8-64.9)	45.9 (35.1-57.2)	290	
Condom use at last sex act	No	67.5 (57.6-76.0)	32.5 (24.0-42.4)	173	0.187
	Yes	59.1 (47.7-69.6)	40.9 (30.4-52.3)	185	
	Not applicable	54.1 (42.8-65.1)	45.9 (34.9-57.2)	282	
Most recent HIV test	Less than 12 months	53.4 (46.0-60.8)	46.6 (39.2-54.0)	336	0.223
	More than a year ago	67.9 (49.9-81.8)	32.1 (18.2-50.1)	71	
	Never tested	62.9 (50.9-73.4)	37.1 (26.6-49.1)	233	
Awareness of HIV status	Yes	57.3 (50.2-64.1)	42.7 (35.9-49.8)	441	0.417
	No	78.2 (52.6-92.1)	21.8 (7.9-47.4)	20*	
	No response	61.1 (46.9-73.7)	38.9 (26.3-53.1)	179	

*****small sample of less than 30 respondents

**p-value<0.05

3.3 Association between behavioural factors and lack of ART use

3.3.1 Univariable logistic regression models for ART non-use

Univariate logistic models were fitted for each of the explanatory variables. Geographical location, employment status, ever had sexual intercourse and age at sexual debut had a significant p-value of less than 0.05 from table 3.3. The odds of ART non-use were significantly less likely among participants residing in rural areas (Crude OR= 0.52; CI: 0.29-0.93; p-value=0.028), students (Crude OR= 0.31; CI: 0.13-0.74; p-value=0.009), those who never had sex (Crude OR= 0.54; CI: 0.31-0.96; p-value=0.032) and those who had their sexual debut at the age of 15 years and above (Crude OR= 0.19; CI: 0.07-0.56; p-value=0.003) (table 3.3). The odds of ART non-use were more likely and not significant among participants aged 20-24 years (Crude OR= 1.39; CI: 0.81-2.38; p-value=0.229) and females (Crude OR= 1.13; CI: 0.64-2.00; p-value=0.662).

Table 3.3 Univariable analysis on factors associated with ART non-use

Factor	Level	Crude OR	95% CI	p-value
Age in years	15-19	1	Reference	
	20-24	1.39	(0.81; 2.38)	0.229
Sex	Male	1	Reference	
	Female	1.13	(0.64; 2.00)	0.662
Race	African	1	Reference	
	Other	0.73	(0.29; 1.86)	0.510
Geographical location	Urban areas	1	Reference	
	Rural areas	0.52	(0.29; 0.92)	0.028**
Province	Western Cape	1	Reference	
	Eastern Cape	1.06	(0.25; 4.55)	0.936
	Northern Cape	0.48	(0.07; 3.26)	0.448
	Free State	0.72	(0.12; 4.31)	0.718
	KwaZulu-Natal	0.35	(0.10; 1.24)	0.104
	North West	0.39	(0.10; 1.56)	0.181
	Gauteng	1.14	(0.29; 4.56)	0.854
	Mpumalanga	0.38	(0.11; 1.32)	0.126
	Limpopo	1.08	(0.24; 4.75)	0.923
Highest level of education	Primary	1	Reference	
	Secondary	1	(0.51; 1.98)	0.995
	Higher education	0.94	(0.24; 3.59)	0.924
Employment status	Employed	1	Reference	
	Unemployed	0.46	(0.20; 1.05)	0.064
	Student	0.31	(0.13; 0.74)	0.009**
Ever had sexual intercourse	Yes	1	Reference	
	No	0.54	(0.31; 0.95)	0.032**
Age at sexual debut	Younger than 15	1	Reference	
	15 years and older	0.19	(0.07; 0.56)	0.003**
Number of sexual partners in the last 12 months	One partner	1	Reference	
	≥2 partners	0.91	(0.33; 2.47)	0.850
	No partners	0.66	(0.38; 1.17)	0.158
Condom use at last sex act	No	1	Reference	
	Yes	0.70	(0.38; 1.27)	0.239
	Not applicable	0.57	(0.30; 1.06)	0.077
Most recent HIV test	< 12 months	1	Reference	
	1 year and more	1.84	(0.82; 4.15)	0.139
	Never tested	1.47	(0.84; 2.58)	0.174
Awareness of HIV status	Yes	1	Reference	
	No	2.67	(0.82; 8.76)	0.104
	No response	1.17	(0.62; 2.22)	0.626

**p-value<0.05

3.3.2 Multivariable logistic regression model for factors associated with ART non-use

Results from table 3.4 show that the odds of ART non-use were higher among females (AOR= 1.17; CI: 0.66-2.06; p-value=0.592) and participants who reside in the Eastern Cape (AOR= 1.74; CI: 0.40-7.58; p-value=0.458), Free State (AOR= 1.06; CI: 0.13-8.45; p-value=0.958), Gauteng (AOR= 1.79; CI: 0.41-7.88; p-value=0.438) and Limpopo (AOR= 3.22; CI: 0.57-18.00; p-value=0.183). The odds of ART non-use were also higher among participants who tested for HIV one or more years ago (AOR= 1.56; CI: 0.67-3.60; p-value=0.299), those who never tested (AOR= 1.78; CI: 0.78-4.00; p-value=0.160) and participants who were not aware of their HIV status (AOR= 3.12; CI: 0.88-11.08; p-value=0.079). The odds were significantly less likely among participants from rural areas (AOR= 0.50; CI: 0.29-0.84; p-value=0.010), students (AOR= 0.23; CI: 0.09-0.63; p-value=0.004) and those who were unemployed (AOR= 0.42; CI: 0.19-0.93; p-value=0.033).

Table 3.4 Multivariable analysis on factors associated with ART non-use

Factor	Level	Adjusted OR	95% CI	p-value
Age in years	15-19	1	Reference	
	20-24	0.74	(0.40;1.37)	0.332
Sex	Male	1	Reference	
	Female	1.17	(0.66;2.06)	0.592
Geographical location	Urban areas	1	Reference	
	Rural areas	0.50	(0.29;0.84)	0.010**
Province	Western Cape	1	Reference	
	Eastern Cape	1.74	(0.40;7.58)	0.458
	Northern Cape	0.44	(0.06;3.00)	0.395
	Free State	1.06	(0.13;8.45)	0.958
	KwaZulu-Natal	0.72	(0.18;2.92)	0.641
	North West	0.75	(0.16;3.42)	0.709
	Gauteng	1.79	(0.41;7.88)	0.438
	Mpumalanga	0.88	(0.22;3.54)	0.857
	Limpopo	3.22	(0.57;18.00)	0.183
Employment status	Employed	1	Reference	
	Unemployed	0.42	(0.19;0.93)	0.033**
	Student	0.23	(0.09;0.63)	0.004**
Ever had sexual intercourse	Yes	1	Reference	
	No	0.55	(0.27;1.11)	0.094
Most recent HIV test	< 12 months	1	Reference	
	1 year and more	1.56	(0.67;3.60)	0.299
	Never tested	1.78	(0.78;4.00)	0.160
Awareness of HIV status	Yes	1	Reference	
	No	3.12	(0.88;11.08)	0.079
	No response	1.29	(0.51;3.22)	0.590

**p-value<0.05

3.4 Spatial analysis

3.4.1 Spatial distribution on ART non-use at the provincial level

Figure 3.1 shows the presence of spatial variation in ART non-use among provinces in South Africa. The provinces with the highest percentage of ART non-use are Limpopo, Gauteng and the Western Cape with percentages between 61.82% and 66.67%. The Northern Cape and Free State followed with percentages between 56.98% and 61.82%.

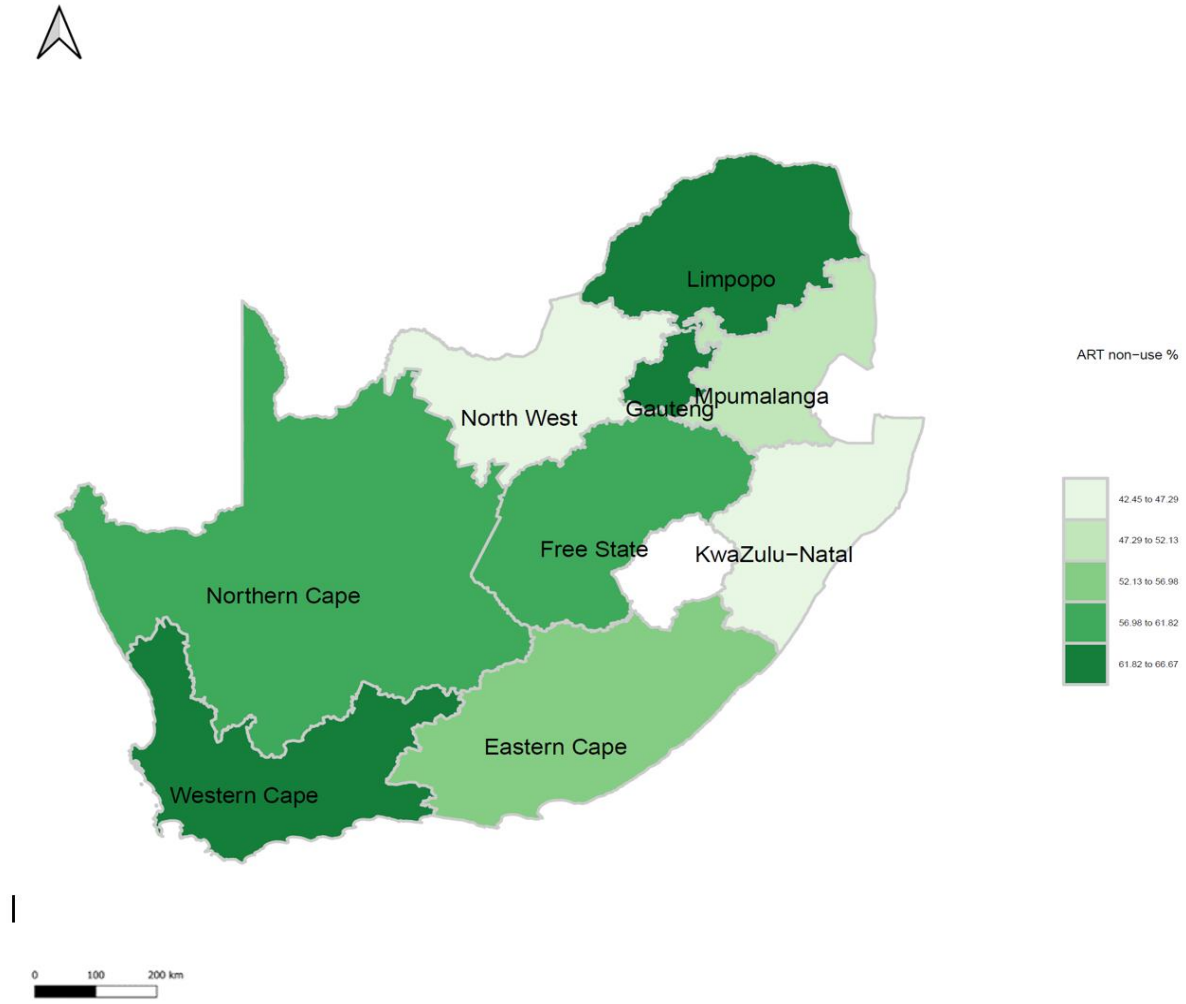


Figure 3.1 ART non-use among 15-24-year-old participants

3.4.2 Spatial logistic regression on factors associated with ART non-use

Results from table 3.5 show that the odds of ART non-use were significantly lower among participants aged 20-24 years (AOR= 0.42; CI: 0.38-0.46; p-value<0.001) and females (AOR= 0.80; CI: 0.72-0.91; p-value<0.001). The odds were also significantly lower among participants residing in the rural areas (AOR= 0.56; CI: 0.50-0.60; p-value<0.001), those from the Northern Cape (AOR= 0.45; CI: 0.37-0.54; p-value<0.001), North West (AOR= 0.80; CI: 0.71-0.09; p-value<0.001) and Gauteng (AOR= 0.59; CI: 0.52-0.67; p-value<0.001) provinces. Results also show that the odds were also lower among participants who were unemployed (AOR= 0.52; CI: 0.47-0.59; p-value<0.001), never tested for HIV prior the primary study (AOR= 0.33; CI: 0.28-0.36; p-value<0.001) and among those who were aware of their HIV status (AOR= 0.69; CI: 0.64-0.75; p-value<0.001).

Table 3.5 Spatial logistic regression analysis on factors associated with ART non-use

Factor	Level	Adjusted OR	95% CI	p-value
Age in years	15-19	1	Reference	
	20-24	0.41	(0.38;0.46)	<0.001**
Sex	Male	1	Reference	
	Female	0.80	(0.72;0.91)	<0.001**
Geographical location	Urban areas	1	Reference	
	Rural areas	0.56	(0.50;0.60)	<0.001**
Province	Western Cape	1	Reference	
	Eastern Cape	1.16	(1.00;1.28)	0.058
	Northern Cape	0.45	(0.37;0.54)	<0.001**
	Free State	1.63	(1.50;1.74)	<0.001**
	KwaZulu-Natal	1.02	(0.83;1.32)	0.880
	North West	0.80	(0.71;0.09)	<0.001**
	Gauteng	0.59	(0.52;0.67)	<0.001**
	Mpumalanga	0.27	(0.24;0.29)	<0.001**
	Limpopo	3.00	(2.84;3.18)	<0.001**
Employment status	Employed	1	Reference	
	Unemployed	0.52	(0.47;0.59)	<0.001**
	Student	1.03	(0.97;1.12)	0.547
Most recent HIV test	< 12 months	1	Reference	
	1 year and more	1.07	(0.98;1.17)	0.239
	Never tested	0.33	(0.28;0.36)	<0.001**
Awareness of HIV status	No	1	Reference	
	Yes	0.69	(0.64;0.75)	<0.001**
	No response	1.50	(1.38;1.73)	<0.001**

**p-value<0.05

Chapter 4: Discussion

This study sought to determine the demographic and behavioural characteristics of HIV-infected youth aged 15-24 who were not on ART. Factors associated with ART non-use were determined and spatial analysis was carried out.

4.1 HIV-infected youth aged 15-24 who are not on ART and factors associated with ART non-use

Findings from this study showed that most of the youth aged 15-24 years who are living with HIV (59.2%) were not on ART. The odds of not being on ART were lower among young adults (aged 20-24 years) compared to the adolescents (aged 15-19 years), which was different to findings from a study on HAART in Kenya among participants aged 15 and above which showed that more participants aged 15–19 years old were optimally adherent compared to the 20–24-year-olds (13). Orphanhood status showed that more orphans were not on ART compared to non-orphans. Having a mother as a primary caregiver was indicated as a reason why 12–17-year-olds were more adherent and not missing clinic visits compared to 18–20-year-olds in a study done in South Arica (29). In this study, adherence was higher in the older age group.

Another finding was that the odds of females not being on ART were higher compared to males, which was different to studies which showed that there were more adherent females aged 12-18 in a study from Malawi and a study in Ethiopia among 15–24-year-olds (20,30). No gender differences for HIV treatment adherence were found amongst males and females aged between 10-20 years old from Botswana who were followed up for two years (31).

The odds of ART non-use were more likely among participants who never had sex. The study did not indicate when participants were infected with HIV, so for non-

sexually active participants, they may have been infected perinatally and were probably not aware of their HIV status. Most participants who were sexually active, were only sexually active after the age of 15. A study in Greece showed that ART use was associated with being aware of ones HIV status (32).

4.2 Spatial variation in the lack of ART use

The lack of ART use may not be influenced by the provincial distribution of the study participants however, this did not minimize the associations noted from the regression models. Some of the results from the spatial regression model were similar to the logistic regression model for some of the variables. The spatial aspect of the study highlighted the issues that are affecting this age group. The odds of ART non-use among females in comparison to the males were however lower which was different to the non-spatial analysis. The need for adolescents and young people to test and be informed of their status if the HIV transmission was perinatal is highlighted in the study. Results for unemployed participants showed that being unemployed lead to lower odds of ART non-use for both spatial and non-spatial logistic regression. Being employed may not encourage one to be cognisant of their health status.

4.3 Strengths and limitations

Most of the study limitations emanate from the primary study. Individuals in residences of educational institutions were excluded from the primary study; this is a limitation since a good number of individuals in the 15 to 24 age group could be living in such residences. The number of respondents who provided a blood sample was low and this had an impact on the number that tested for HIV. Participants who were aware of their HIV status, might have decided not to provide a blood sample for HIV testing. The samples that were tested for the presence of ART were even lower, this resulted in fewer participants remaining in the different provinces. This made it more difficult for analysis at district level to be conducted as even fewer responses remained in the smaller sections dividing provinces. Geographical coordinates of study participants were not captured, and this had a limitation on spatial analysis and

the type of analysis that could have been explored. Among participants who indicated that they knew their HIV status, it would have been interesting to find out how they acquired HIV, specifically those who indicated that they had never sex. This type of study offered an opportunity to be able to determine what is happening with young people and it helped to see how honest the participants were in providing information on sensitive topics such as sexual behaviour. Spatial analysis in the study which showed geographical differences when it comes to ART non-use also offered an opportunity for further investigations in the different provinces.

Chapter 5: Conclusion and recommendations

This secondary analysis was able to determine some of the gaps on ART use which exist among the 15-24 years age group. Young people living with HIV need support, encouragement and reminders to adhere to medication. The importance of HIV testing as well as knowing one's HIV status has proven to have an impact on whether ART will be taken or not.

Support systems aimed at young people living with HIV should be implemented in communities. They should be able to close the gap that emanates from orphans living with HIV, who may struggle with receiving support from parents or guardians. More interventions are needed for females despite efforts being made by the DREAMS (Determined, Resilient, Empowered, AIDS-free, Mentored and Safe) initiative.

HIV testing in communities and schools should be encouraged. HIV and ART programmes targeted at adolescents and youth that offer support should also be implemented in communities and schools. Knowing one's HIV status has an impact on early detection of the HIV virus and this should lead to early initiation of the treatment. Having flexible appointments for young people to collect treatment even in public facilities could offer them the peace needed knowing that treatment is always available even in odd hours. Collecting treatment from local pharmacies or even community centres could also reduce the time it takes to go to public hospitals as well as making the youth feel at ease as this increases privacy. Parents/guardians of children living with HIV should also be provided with support and educated on the importance of disclosing the children's HIV status to them as an effort to educate them about adhering to medication.

Sex education in schools should highlight the importance of delaying sexual activity. The 6th wave of the SABSSM study will offer an opportunity to see what changes exist in this age group. Having these kinds of surveys focusing on young people will offer more opportunities to see gaps emanating from interventions that have been undertaken. Further research focusing on the spatial aspects of ART non-use should be explored.

References

1. UNAIDS 2021 epidemiological estimates. UNAIDS Fact Sheet - World AIDS day 2021 [Internet]. 2021 [cited 2022 May 3]. Available from: https://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_en.pdf
2. Sheet F, Day WA, People V. Global HIV statistics 26.0. UNAIDS. 2020;(June):1–6. cited 2022 May 10]. Available from: https://www.unaids.org/en/resources/documents/2020/unaids-data
3. World Health Organization. 2016 Annual Report Communicable Diseases Cluster. 2016;1–48. [cited 2022 May 3] https://www.afro.who.int/publications/who-country-office-annual-report-2016
4. Communications and Global Advocacy UNAIDS. UNAIDS FACT SHEET. Global HIV Statistics. Ending the AIDS epidemic. 2020;1–3.
5. WHO Regional Office for Africa. AIDS HIV / AIDS : strategy for the who african region. World Health Organization Regional Office for Africa. 2013;27.
6. Marsh K, Eaton JW, Mahy M, Sabin K, Autenrieth CS, Wanyeki I, et al. Global, regional and country-level 90-90-90 estimates for 2018: Assessing progress towards the 2020 target. AIDS. 2019 Dec 15;33:S213–26.
7. Mid-year population Estimates, 2022 Risenga Maluleke Statistician-General Statistics South Africa. [Internet]. 2022 [cited 2022 May 4]. Available from: https://www.statssa.gov.za/
8. UN Joint Programme on HIV/AIDS (UNAIDS). to help end the AIDS epidemic. United Nations. 2014; [cited 2022 June 1]. Available from: https://www.unaids.org/en
9. WHO. Preventing and Responding to HIV Drug Resistance in the African Region. 2019. 1–38 p. [cited 2022 June 1]. Available from: https://www.afro.who.int/publications/preventing-and-responding-hiv-drug-resistance-african-region-regional-action-plan-2019
10. UNAIDS Global AIDS Update. Confronting Inequalities - Lessons for pandemic responses from 40 years of AIDS [Internet] [cited 2022 May 10]. Available from: https://www.unaids.org/en/resources/documents/2021/2021-global-aids-update
11. UNAIDS. 2025 AIDS TARGETS [cited 2022 May 3] Available from: https://aidstargets2025.unaids.org/
12. UNAIDS. UNAIDS Global AIDS Update 2022. 2022. [Internet]. 2021. Available from: https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update

13. Collins K, Magu D, Mokaya D. Predictors of adherence to highly active antiretroviral therapy (HAART) among HIV patients attending selected comprehensive care centres (CCC) in Kericho county. Journal of Health, Medicine and Nursing (JHMN) [Internet]. 2021;6(1):1–13. Available from: www.iprjb.org

14. Lee L, Yehia BR, Gaur AH, Rutstein R, Gebo K, Keruly JC, et al. The impact of youth-friendly structures of care on retention among HIV-infected youth. AIDS Patient Care STDS. 2016 Apr 1;30(4):170–7.

15. Meloni ST, Agaba P, Chang CA, Yiltok E, Oguche S, Ejeliogu E, et al. Longitudinal evaluation of adherence, retention, and transition patterns of adolescents living with HIV in Nigeria. PLoS One. 2020 Jul 1;15(7 July).

16. Hornschuh S, Dietrich JJ, Tshabalala C, Laher F. Antiretroviral Treatment Adherence : Knowledge and Experiences among Adolescents and Young Adults in Soweto , South Africa. AIDS Res Treat. 2017;2017.

17. Tsondai PR, Sohn AH, Phiri S, Sikombe K, Sawry S, Chimbetete C, et al. Characterizing the double-sided cascade of care for adolescents living with HIV transitioning to adulthood across Southern Africa. 2020; Available from: http://onlinelibrary.wiley.com/doi/10.1002/jia2.25447/full

18. Wasti SP, Simkhada P, Randall J, Freeman J V, Van Teijlingen E. Factors Influencing Adherence to Antiretroviral Treatment in Nepal: A Mixed-Methods Study. PLoS One [Internet]. 2012; Available from: www.plosone.org

19. Kahana SY, Jenkins RA, Bruce D, Fernandez MI, Bauermeister JA, Medicine A, et al. Structural Determinants of Antiretroviral Therapy Use , HIV Care Attendance , and Viral Suppression among Adolescents and Young Adults Living with HIV. PLoS One. 2016;11(4):1–19.

20. Kim MH, Mazenga AC, Yu X, Ahmed S, Paul ME, Kazembe PN, et al. High self-reported non-adherence to antiretroviral therapy amongst adolescents living with HIV in Malawi: barriers and associated factors. J Int AIDS Soc [Internet]. 2017 Jan 1 [cited 2022 Jun 20];20(1):21437. Available from: https://onlinelibrary.wiley.com/doi/full/10.7448/IAS.20.1.21437

21. Zanoni BC, Sibaya T, Cairns C, Lammert S, Haberer E. Higher retention and viral suppression with adolescent-focused HIV clinic in South Africa. PLoS One. 2017;12(12):1–12.

22. Rana Y, Haberer J, Huang H, Kambugu A. Short Message Service (SMS) - Based Intervention to Improve Treatment Adherence among HIV-Positive Youth in Uganda : Focus Group Findings. PLoS One. 2015;10(4):1–14.

23. Adolescents and Young Adults with HIV | NIH [Internet]. [cited 2022 Jul 4]. Available from: https://clinicalinfo.hiv.gov/en/guidelines/hiv-clinical-guidelines-adult-and-adolescent-arv/adolescents-and-young-adults-hiv

24. Lawson A, Lee D. Bayesian Disease Mapping for Public Health. Handbook of Statistics. 2017 Jan 1;36:443–81.

25. Nutor JJ, Duah HO, Agbadi P, Duodu PA, Gondwe KW. Spatial analysis of factors associated with HIV infection in Malawi: Indicators for effective prevention. BMC Public Health. 2020;20(1):1–15.

26. Simbayi LC, Zuma K, Zungu N, Moyo S, Marinda E, Jooste S, Mabaso M, Ramlagan S, North A, van Zyl J, Mohlabane N, Dietrich C NI and the SVT (2019). South African national HIV prevalence, incidence, behaviour and communication survey, 2017. HSRC Pres. Cape Town; 2019.

27. Statistics South Africa. CENSUS 2011 10% SAMPLE METADATA ii. 2015. [cited 2022 May 5] Available from: https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/485

28. Moyo S, Hunt G, Zuma K, Zungu M, Marinda E, Mabaso M, et al. HIV drug resistance profile in South Africa: Findings and implications from the 2017 national HIV household survey. PLoS One. 2020;15(11 November).

29. Maskew M, Fox MP, Evans D, Govindasamy D, Jamieson L, Malete G, et al. Insights into Adherence among a Cohort of Adolescents Aged 12-20 Years in South Africa: Reported Barriers to Antiretroviral Treatment. AIDS Res Treat. 2016;2016.

30. Girum T, Wasie A, Lentiro K, Muktar E, Shumbej T, Difer M, et al. Gender disparity in epidemiological trend of HIV/AIDS infection and treatment in Ethiopia. Archives of Public Health. 2018 Sep 17;76(1).

31. Ioannides KLH, Chapman J, Marukutira T, Tshume O, Anabwani G, Gross R, et al. Patterns of HIV Treatment Adherence do not Differ Between Male and Female Adolescents in Botswana. AIDS Behav. 2017 Feb 1;21(2):410–4.

32. Pavlopoulou ID, Dikalioti SK, Gountas I, Sypsa V, Malliori M, Pantavou K, et al. High-risk behaviors and their association with awareness of HIV status among participants of a large-scale prevention intervention in Athens, Greece. BMC Public Health. 2020 Jan 28;20(1).

Appendix

Appendix 1: Individual questionnaire

Demographics

- Age, sex, race, province,
- Geographical location (Urban or rural area)
- Highest level of education
- Employment status (Employed, unemployed or student)
- Orphanhood status (Mother and/or father alive)

Sexual history

- Ever had sex (yes/no)
- Age at sexual debut
- Number of partners in the last 12 months
- Condom use at last sex (yes/no)

HIV testing history

- Most recent HIV test
- Awareness of HIV status (yes/no)

Appendix 2: Ethical clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO:	Ms G Maseko School of Public Health Division of Epidemiology and Biostatistics Medical School University E-mail: 1570883@students.wits.ac.za
CC:	Supervisor: Professor J Levin <Jonathan.Levin@wits.ac.za> and <HREC-Medical Research Office@wits.ac.za>
FROM:	Mr Iain Burns Human Research Ethics Committee (Medical) Tel: 011 717 1252 E-mail: Iain.Burns@wits.ac.za
DATE:	2021/10/06
REF:	R14/49
PROTOCOL NO:	**M210662** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)
PROJECT TITLE:	*Factors associated with failure to initiate ART amongst youth aged 15-24 years in South Africa: A secondary analysis*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

Appendix 3: Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

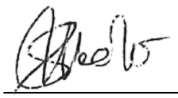
PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Goitseone Maseko (Student number: 1570883) am a student registered for the degree of MSc Epidemiology (Biostatistics) in the academic year 2023.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 31 March 2024