Determinants of viral suppression among adolescents on antiretroviral therapy in the Sedibeng District, Gauteng province

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KEY WORDS

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Adolescents

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Viral Load

Virologic failure

Retention in care

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ABSTRACT

Background: Approximately 1.75 million adolescents (10-19 years old) globally were living with human immunodeficiency virus (HIV) in 2020, with the Eastern and Southern African regions the most affected by HIV. Progress has been made to increase access to antiretroviral therapy (ART) for adolescents living with HIV (ALHIV) to improve their survival. However, ALHIV still have worse treatment adherence and viral suppression compared to adults and children. This is in part because routine monitoring of HIV treatment programmes does not report for ALHIV; thus making their lack of progress in ART not visible. It is imperative to determine viral suppression and the factors that are associated with viral suppression among adolescents to assess treatment outcomes at local service levels.

Aim: To determine the factors associated with viral suppression among adolescents aged 10-19 years on ART at the Levai Mbatha Community Health Centre (CHC) in the Sedibeng District.

Methodology: A quantitative cross-sectional survey was conducted at the Levai Mbatha CHC, Sedibeng District among 192 adolescents who were on ART for at least six months and had at least one viral load documented in the period between 2015 and 2018. A self-developed data extraction tool was used to collect data from the Tier.Net electronic database and clinical folders. Factors such as educational status, adherence, alcohol and substance use, support, other medication and history of TB were extracted from clinical folders. Data was captured on Microsoft Excel, and descriptive and inferential analyses were performed using SPSS 27 statistical software.

Results: The prevalence of viral suppression (<1000 copies/ml) among adolescents on ART was 74%, with 41% achieving full suppression (<50 copies/ml). In the bivariate analysis, only adherence to ART was significantly associated with viral suppression (*p=<0.001*). No relationship was observed between viral suppression and baseline, clinical and other behavioural characteristics.

Conclusions: Viral suppression among adolescents on ART at the Levai Mbatha CHC was higher compared to other settings in South Africa, but still way too short of UNAIDS targets. Tailored interventions are recommended to address adherence problems amongst ALHIV on ART in the Sedibeng District.

DECLARATION

I declare that this mini-thesis entitled *Determinants of viral suppression among adolescents on antiretroviral therapy in the Sedibeng District, Gauteng province* is my own work, has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been acknowledged by complete references.

Full Name: Sibongile Elizabeth Mabizela

Date: 11 November 2021

Signed: 

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ABBREVIATIONS AND ACRONYMS

A3E	Abacavir + Lamivudine + Efavirenz
A3N	Abacavir + Lamivudine + Nevirapine
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
CD4	Cluster of Differentiation 4
CDC	Centers for Disease Control and Prevention
CHC	Community Health Centre
EAC	Enhanced adherence counselling
HAST	HIV, AIDS, Sexually Transmitted Infections and TB
HIV	Human Immunodeficiency Virus
IQR	Interquartile Range
LMICs	Low- and middle-income countries
NNRTI	Non-nucleoside reverse transcriptase inhibitor
NRTI	Nucleoside reverse transcriptase inhibitor
NDOH	National Department of Health
PHC	Primary Health Care
PMTCT	Prevention of Mother to Child Transmission
T3E	Tenofovir + Lamivudine + Efavirenz
T3L	Tenofovir + Lamivudine + Lopinavir/ritonavir
TFE	Tenofovir + Emtricitabine + Efavirenz
TB	Tuberculosis
UNAIDS	Joint United Nations Programme on HIV and AIDS
UNICEF	United Nations International Children's Emergency Fund
VL	Viral Load
WHO	World Health Organization
Z3E	Zidovudine + Lamivudine + Efavirenz

CHAPTER 1: INTRODUCTION

1.1 Background

Human Immunodeficiency Virus (HIV) remains one of the world's most significant public health challenges, particularly in low-and middle-income countries (World Health Organization, 2020). More than three decades into the global HIV pandemic, it has been estimated that 150 000 (44 000-310 000) adolescents aged 10-19 years were newly infected with HIV and 1.75 million (1.16-2.3 million) adolescents were living with HIV in 2020 globally, which accounts for 5% of all people living with HIV (United Nations International Children's Emergency Fund [UNICEF], 2021). Sub-Saharan Africa continues to bear an unequal portion of the global HIV infections. In Eastern and Southern Africa, 120 000 (31 000-250 000) adolescents aged 10–19 years were estimated to be newly infected with HIV in 2018 and 1.1 million (750 000-1.6million) adolescents were living with HIV (UNICEF, 2019).

Among the Eastern and Southern African countries, South Africa (SA) was found to have the highest number of children and adolescents aged 0–19 years living with HIV in 2018 with estimates at 460 000 (UNICEF, 2019). Although the occurrence of HIV remains high in SA, the national HIV prevalence and incidence survey documented declines amongst children under 14 years old from 9.3% in 2002 to 7.1% in 2012 and among youth aged 15-24 years from 7.3% in 2002 to 4.6% in 2017 (Simbayi et al., 2019).

Over the years, significant progress has been made in increasing access to antiretroviral therapy (ART) for people living with HIV through the comprehensive care, management and treatment programme by the South African Department of Health (UNAIDS, 2016; Johnson, 2012). The scale-up of HIV treatment provides an opportunity for the survival and long-term well-being of HIV-positive adolescents (Cluver et al., 2016). SA had nearly 3.4 million people living with HIV initiated on treatment by 2015 (UNAIDS, 2016). The number of adolescents aged 15–19 years, receiving ART in SA has increased tenfold between 2005–2008 and 2013–2016 (Maskew et al., 2019). This increase is attributed to perinatally infected infants surviving to adolescence and a rising incidence of HIV in behaviourally infected 15–19-year-olds (Van Wyk et al., 2020). A key goal of ART is to suppress the replication of the virus, restore the immune function, reduce the risk of onward HIV transmission and prolong the average life expectancy of HIV-infected individuals (Edessa et al., 2019). Monitoring of patients on ART

is crucial in the evaluation of the effectiveness of HIV treatment (Johnson, 2012). In 2013, WHO recommended routine HIV viral load (VL) testing to monitor ART responses (Chhim et al., 2018). In addition to demonstrating the effectiveness of ART in suppressing the virus, VL testing may be useful to identify persons who are likely to be resistant to treatment, and allow for further considerations for regimen change for the patient (Sithole et al., 2018; WHO, 2013). In SA, the initial VL test is done 6 months after ART initiation and repeated every 12 months thereafter (Kubheka et al., 2020). VL below 1000 copies/ml after at least 6 months of ART is considered as viral suppression (UNAIDS/WHO, 2015), while virologic failure (VF) is VL above 1000 copies/ml on two consecutive measures, in the presence of adherence support being provided to the patient (Bernheimer et al., 2015; National Department of Health [NDOH], 2020). According to WHO (2016), viral monitoring is critical for ART patients for early detection of treatment failure and to signal for enhanced adherence counselling (EAC) to be implemented. Recognising treatment failure early and changing the regimen to an effective one is important to avoid the development of resistance (Sang and Miruka, 2016).

A high level of adherence to ART is a pre-requisite to ensure virologic success in HIV patients (Lacob et al., 2017). Adolescents generally find consistent, long-term medication adherence difficult, and HIV treatment is no exception (Ferrand et al., 2016). Kim et al. (2014) reported an adherence rate of 70-85% among youth aged 12–24 years in Africa and Asia. Among the same group, ART discontinuation was frequently reported. According to Bulage et al. (2017), drug intolerance and suboptimal adherence are the major causes of regimen discontinuations and VF. They further indicated that generally, viral non-suppression (≥1000 copies/ml) was highest amongst patients with adherence levels of less than 85% followed by patients with adherence levels of 85–94% and least among those with adherence levels >95% (Bulage et al., 2017). Evans et al. (2013) and Nglazi et al. (2012) stated that adolescents on ART are more likely to have an unsuppressed VL and more likely to fail virologically compared to adults. This may be attributed to poor adherence and clinic attendance.

The Joint United Nations Programme on HIV/AIDS (UNAIDS) (2014) set goals towards ending the AIDS epidemic by 2020, that included having 90% of all people living with HIV to know their HIV status, 90% of people who know their status to be on HIV treatment and 90% of people on treatment to be virally suppressed. Davies and Pinto (2015) revealed that gaps in HIV diagnosis and treatment continue to exist among infants, children and adolescents, which further prevent attaining viral suppression. In one SA study, viral suppression (< 50 copies/ml)

rates of 65.1% among adolescents were reported (Crowley et al., 2020). Vreeman et al. (2017) highlighted that in many settings, guidance to help adolescents to transition into adult care are lacking and that physicians do not have adequate skills to aid in this transition.

1.2 Problem statement

Despite the successful rollout of ART in South Africa and initiating HIV positive adolescents on treatment, adolescents demonstrate poor ART adherence, retention in care (RiC) and viral suppression as compared to adults and children (Van Wyk and Davids, 2019; Van Wyk et al., 2020). Van Wyk et al. (2020a) point out that HIV treatment programmes are designed for either paediatrics (children under 15 years) or adults and do not cater for the specific needs of adolescents. The high prevalence of suboptimal viral suppression among this group is an ongoing challenge in many sub-Saharan African settings. Further, routine monitoring of HIV treatment does not report treatment outcomes for adolescents aged 10–19 years, but reporting is only for children aged 0–14 years and adults 15 years and older (Van Wyk et al., 2020). As adolescent treatment outcomes are masked in the routine monitoring of HIV programmes, it is difficult to assess how well or poor adolescents in the HIV programme are performing. Therefore, it is essential to analyse routinely collected data for adolescents specifically. Such information can inform proper planning for adolescent-specific interventions. In particular, it is essential to identify factors that influence treatment outcomes for adolescents on ART in the Sedibeng District, Gauteng province as this has not been done at the time of the current study.

1.3 Outline of the mini thesis

Chapter 2: Explores the literature on factors associated with viral suppression among adolescents in other parts of the world including sub-Saharan Africa. Literature on factors associated with viral suppression among adolescents is limited.

Chapter 3: Illustrates the methodology of the study. It describes the aim of the study, which is to determine factors associated with viral suppression among adolescents on ART in Sedibeng.

Chapter 4: Reveals the study results with statistical figures to allow interpretation conclusions to be drawn.

Chapter 5: Presents a discussion of the results, relating the results to other studies of a similar topic.

Chapter 6: Presents a conclusion and provides recommendations relating to the study findings.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The proportion of adolescents achieving viral suppression vary extensively by setting. Viral suppression rates for children below 15 years on ART in low- and middle-income countries (LMICs) range from 40–90% (Kadima et al., 2019).

In South Africa (SA), a viral suppression rate of 81% has been reported among adolescents and young people aged 15-24 years (Zanoni et al., 2016). Zanoni et al. (2017) added that viral suppression was higher among adolescents and young people attending adolescent versus standard pediatric clinics (91% vs 80%). In countries such as Uganda and Cambodia, low viral suppression rates have been reported among adolescents aged 10-19 years at 65.5% and among adolescents 15–17 years at 76.8% (Chhim et al., 2018; Natukunda et al., 2019).

The factors that influence viral suppression are categorised as sociodemographic, clinical and behavioural factors. Each of these categories will be discussed in turn.

2.2 Sociodemographic factors

Sociodemographic factors such as age, gender, education and social support have been reported to be associated with viral suppression.

Older *age* among adolescents has been associated with viral suppression (<1000 copies/ml) in Cambodia and was related to the increasing treatment experience among older long-term survivors (Chhim et al., 2018). Similarly, Bulage et al. (2017) associated viral non-suppression (≥1000 copies/ml) with younger age in Uganda due to multiple treatment challenges. In SA, Van Wyk et al. (2020) reported that older adolescents (15-19 years) were observed to have lower rates of VL suppression than younger adolescents. The authors posited that adolescents experience significant adherence problems when transitioning from the paediatric to adult HIV programmes. Similar results were described in Namibia by Munyayi and Van Wyk (2020), where it was reported that older adolescents had lower odds of viral suppression (40–999 copies/ml) compared to younger adolescents. However, Natukunda et al. (2019) in their study found no significant association between age and viral suppression (<1000 copies/ml) among adolescents in Uganda.

Being *female* was largely associated with a higher viral suppression (≤ 1000 copies/ml) (Diress et al., 2020). Fokam et al. (2019) reported that females were more likely to experience virological success than males in Cameroon. This was justified by men engaging in high risk-related behaviours such as having multiple sex partners to express their manhood, refusing to use condoms, and abusing alcohol and substances, leading to poor adherence, treatment interruption and subsequent treatment failure (Fokam et al., 2019). Similarly, Desta et al. (2020), Joseph Davey et al. (2018) and Kadima et al. (2019) associate being male with viral non-suppression in Ethiopia (>1000 copies/ml), South Africa (>400 copies/ml) and Kenya (>1000 copies/ml) respectively, which may be attributed to low health-seeking behaviour among males. In Tanzania though, Muri et al. (2017) found a significant association between VF and being female whereas Jobanputra et al. (2015) and Dixon-Umo and Ikpeme (2020) in their studies reported conflicting findings that no significant association was found between gender and viral suppression in Swaziland (<100 copies/ml) and Nigeria (<1000 copies/ml).

Education was associated with viral suppression and decreased rates of AIDS and mortality (Carter, 2016). According to Kahana et al. (2016), youth with a high school education or greater were likely to be virally suppressed, and Diress et al. (2020) further reported that primary or secondary and above educational status were associated with viral suppression (≤1000 copies/ml) compared to those who cannot read and write. This is possibly due to the fact that educated people typically engage in healthier behaviours including ART drug adherence and they have a better understanding of information during EAC sessions (Diress et al., 2020). Contrary to this finding, Natukunda et al. (2019) and Yiltok et al. (2020) found no significant association between education (school attendance) and viral suppression (<1000 copies/ml) among adolescents in Uganda and Nigeria.

Social support has been linked to improved ART adherence and viral suppression. Sithole et al. (2018) demonstrated that having a support group was protective against VF. Peer support has been reported as a major source of social support and information among adolescents in relation to living with HIV (Okonji et al., 2020). Mark et al. (2019) revealed that peer support programmes have demonstrated an impact on improving health-seeking behaviour and HIV treatment outcomes such as linkage, adherence to ART, RiC and viral suppression. Contrary, the teen club model was found not to improve adherence and virologic suppression (40–999 copies/ml) for adolescents in Namibia's specialised paediatric ART clinic, which may depend on other factors besides levels of adherence to treatment (Munyayi and Van Wyk., 2020).

Robinson and Knowlton (2016) also mentioned that even though females living with HIV have reported higher levels of social support in general, they tend to achieve less viral suppression (≤40 copies/ml) compared to males living with HIV.

Parents being alive was a significant association with viral suppression (<1000 copies/ml), and this could be due to positive parental support (Dixon-Umo and Ikpeme, 2020). Family members, particularly parents, commonly remind patients to take their antiretroviral medications, get medication resupplies, and sometimes accompany them to the clinic for appointments. Likewise, parents or caregivers being on routine medications was significantly associated with viral suppression (Knodel et al., 2010). Knodel et al. (2010) concluded in their study that parents or caregivers on routine medications may encourage their children to achieve good adherence leading to viral suppression.

2.3 Clinical factors

Clinical factors that are of significance in treatment outcomes of patients on ART are the WHO staging at ART initiation, baseline CD4 cell count, current CD4 cell count and the presence of opportunistic infections (Ayele et al., 2015).

The *WHO clinical staging* system was developed in 1990 and revised in 2005 to assign patients to a particular stage when they show at least one clinical condition in the stage's criteria. For persons aged 15 years or older, the classifications are: stage 1 (primary HIV infection); stage 2 (mildly symptomatic); stage 3 (moderately symptomatic); and stage 4 (severely symptomatic) (Weinberg and Kovarik, 2010). For children under 15 years the classifications are: stage 1 (asymptomatic); stage 2 and 3 (moderately symptomatic); and stage 4 (severely symptomatic) (WHO, 2005). Having WHO clinical stages 3 or 4 disease has been associated with VF among children and adolescents in Swaziland and Zimbabwe (Jobanputra et al., 2015; Sithole et al., 2018). Nabukeera et al. (2021) also reported that being at WHO clinical staging 4 at ART initiation was significantly associated with virological non-suppression (≥1000 copies/ml) among children in Uganda, which is likely because children have advanced HIV infection with severe symptoms like a very low CD4 cell count as well as rapid disease progression, with AIDS-defining illnesses like pneumocystis pneumonia, toxoplasmosis and cytomegalic infections, among others. In contrary to these findings, Natukunda et al. (2019) found no association between WHO clinical staging and viral suppression (<1000

copies/ml) among adolescents in Uganda.

CD4 cell count is the number of CD4 cells in a blood sample. It provides information on the disease progression and immune system in people living with HIV (Hughson, 2017). Prior to 2015, CD4 count was used together with WHO clinical staging to determine the patients' eligibility for ART. The reason behind this was after a primary HIV infection, the virus directly attacks CD4 T lymphocyte cells and begins to destroy them while at the same time using them as host cells for replication (Murtagh, 2011). However, the 2015 guidelines strongly recommended ART be initiated for all people living with HIV irrespective of the CD4 cell count and WHO clinical stage (WHO, 2015).

Baseline CD4 cell count is the most important factor in immune recovery (Stirrup et al., 2018), with a higher CD4 cell count indicating a strong immune system. Baseline CD4 cell count was known to be an important determinant factor for antiretroviral treatment failure. It increases the risk and episodes of opportunistic infections and a high attrition rate (Babo et al., 2017). Muri et al. (2017) reported that a higher CD4 cell count at ART initiation was associated with better viral suppression (<1000 copies/ml) at 12 months after ART initiation in Tanzania. Similarly, Jobanputra et al. (2015) and Desta et al. (2020) reported that CD4 cell count of <350 cells/µL were likely to show VF in Swaziland, and CD4 count of < 200 cells/µL and 200-499 cells/µL were significantly associated with viral non-suppression (≥1000 copies/ml) in Ethiopia.

Current CD4 count has also been associated with viral suppression. In Ethiopia, the current CD4 cell count of < 200 cells/µL was associated with viral non-suppression (≥1000 copies/ml) compared to a CD4 cell count of ≥500 cells/µL (Desta et al., 2020). Similarly, Jobanputra et al. (2015) reported a current CD4 cell count of <350 cells/µL to be associated with VF in Swaziland.

Opportunistic infections (OIs) are illnesses that occur more frequently and are more severe in people living with HIV as a result of damaged immune systems (Centers for Disease Control and Prevention, 2020). Opportunistic infections remain the single main cause of ill-health and death among HIV-infected patients (Rubaihayo et al., 2015).

Bulage et al. (2017) revealed that having an active tuberculosis (TB) infection, an infectious disease common among HIV-infected people because of the weakened immune system (Avert,

2020), was associated with low viral suppression (<1000 copies/ml) in all age groups in Uganda. Joseph Davey et al. (2018) additionally reported that South African patients on TB treatment were reported to have a very low viral suppression (<400 copies/ml). On the contrary, a history of TB among children was associated with better virologic outcomes as opposed to no history of TB in Western Kenya (Kadima et al., 2019). This may be due to close observation, treatment and adherence support, which included directly observed therapy (DOT) supplied as part of tuberculosis treatment. Jobanputra et al. (2015) in their study reported no association between TB co-infection and VF in Swaziland. Rabie and Goussard (2016) stated that young age is one of the most important risk factors for developing severe TB disease, yet young age is poorly studied as a risk factor in HIV-infected children in resource-limited settings.

Rabie and Goussard (2016) indicated that *Pneumocystis jirovecii* and cytomegalovirus are also important opportunistic pathogens. They further highlighted that as the vertical transmission risk of HIV decreases and access to ART increases, the epidemiology of these infections changes, but HIV-infected children still carry a disproportionate burden of these infections. In contrast to other studies, Wakooko et al. (2020) found no association between opportunistic infections and viral suppression where opportunistic infections are caused by pathogens that take advantage of a weakened immune system.

2.4 Treatment factors

Treatment factors associated with viral suppression include ART regimen, duration on ART and other medication.

ART regimen such as Nevirapine (NVP) has been long used for prevention of mother to child transmission (PMTCT) and being a non-nucleoside reverse transcriptase inhibitor (NNRTI)-based regimen, it has been associated with greater risk of VF (Bunupuradah et al., 2011; Makadzange et al., 2015). Muri et al. (2017) reported that children and adolescents on the NNRTI-based regimen were likely to acquire drug resistance mutation (DRM) than those on protease inhibitor (PI)-based regimens in Tanzania. In Kenya, Kadima et al. (2019) additionally reported that fewer children achieved virologic suppression (<1000 copies/ml) after failure was detected, however, the odds of virologic suppression were considerably higher for children on PI-based regimens compared to NNRTI-based regimens. These results suggest that PI-based

regimens have good performance in viral suppression and prevention of DRM (Muri et al., 2017; Fokam et al., 2019).

In SA, it was found that children receiving Lopinavir/ritonavir (LPV/r) or Efavirenz (EFV)-based plus Abacavir/Lamivudine (ABC/3TC) regimens were less likely to achieve viral suppression (<400 copies/ml) and had a higher rate of VF than those receiving stavudine (d4T)/3TC (Technau et al. 2013). Lamivudine (3TC) and d4T were initially used as standard first-line nucleoside reverse transcriptase inhibitor (NRTI) backbones. Since 2010 following WHO recommendations, the South African guidelines have replaced d4T with ABC for children and younger adolescents and d4T with Tenofovir (TDF) for older adolescents due to concerns around its toxicity (Technau et al. 2013; NDOH, 2015). The guidelines further recommended treatment with LPV/r-based regimens for children under 3 years of age and EFV-based regimens for children older than 3 years of age and adolescents 10-15 years (Technau et al. 2013; NDOH, 2015). Chouraya et al. (2019) in their study reported that children below 15 years who received EFV-based regimens were more likely to be virally suppressed (<1000 copies/ml) than those on NVP- or LPV/r-based regimens. They further emphasised that nonetheless, those on LPV/r were statistically significantly more likely to be suppressed when it was combined with the NRTI backbone of Zidovudine (AZT)/3TC versus ABC/3TC (Chouraya et al., 2019).

Dixon-Umo and Ikpeme (2020) revealed that in Nigeria adolescents on a fixed-dose TDF/3TC/Dolutegravir (DTG) regimen experienced better viral suppression as compared to those on ABC/3TC/EFV or LPV/r, because the once-daily fixed-dose regimen decreased the pill burden; thereby making adherence to ART easier. Additionally, patients who were switched to a second- or third-line regimen had a low risk of virological non-suppression (≥1000 copies/ml) (Bulage et al., 2017). In contrast, Munyayi and Van Wyk (2020) reported that adolescents on the first-line ART regimens were more likely to be suppressed (40-999 copies/ml) than those on a second-line regimen, and they posited that those on second-line regimen may be indicative of initial adherence problems. However, Jobanputra et al. (2015) in their study found no association between ART regimens with VF in Swaziland.

The *duration of an HIV-positive patient on ART* has been associated with viral suppression in different studies. This association implies the effectiveness of ART in improving the immune system (Kikuchi et al., 2021). In Ethiopia, the chance of viral suppression (<1000 copies/ml)

was lower for those on ART for 13–59 months as compared to those on ART for less than 12 months, probably because of the association with the destruction of CD4 cells over time (Diress et al., 2020). Similarly, Sithole et al. (2018) in their study reported that in Zimbabwe adolescents on ART for less than 18 months were less likely to develop VF compared to those with more than 18 months on ART. In agreement with the findings of Sithole et al. (2018), Fokam et al. (2019) also reported that VF was associated with a longer stay on ART in Cameroon. The individual increase in the lack of tolerability and the emergence of multi-strain viruses with time greatly accounted for the reduced viral suppression. Contrary to findings from Zimbabwe, Ethiopia and Cameroon, Haghighat et al. (2021) stated that adolescents on ART for longer were more likely to be fully virally suppressed at <50 copies/ml in SA. This is expected given that it takes time for ART to fully suppress the HIV replication process. Chouraya et al. (2019) in their study reported no association between ART duration with viral suppression or an undetectable VL (<400 copies /ml) among children <15 years in Swaziland.

The *use of other medication* while on ART has been associated with poor viral suppression. According to Sithole et al. (2018), adolescents who were on other medication apart from ART were 1.5 times more likely to develop VF as compared to those who were on ART only. Likewise, those who had a chronic illness and are taking other chronic medication were almost three times more likely to develop VF as compared to those who were not (Sithole et al., 2018). The reason behind this challenge could be due to the pill burden encountered by adolescents while taking other medication. Other medication besides ART were not significantly associated with viral suppression in Uganda (Wakooko et al., 2020).

2.5 Behavioural factors

Behavioural and social factors that influence viral suppression include ART adherence, retention in care (RiC), alcohol and substance abuse, and disclosure.

Adherence to ART is a key predictor of treatment success. Sufficiently high levels of adherence to therapy are necessary to achieve and sustain viral suppression and to prevent disease progression and death, nonetheless, many HIV-infected people do not succeed in achieving or maintaining adequate levels of adherence to treatment (Ghanbari et al., 2019). A lack of adherence and inadequate psychological support represent the major reasons for the failure to follow-up and VF in children and adolescents (Fokam et al., 2019).

Poor adherence due to poor palatability of drugs and reliance on parents or caregivers to give medications, pre-treatment drug resistance, complex weight-based dosing, and lack of clinicians confidence in treating children with HIV have been documented as barriers to viral suppression (Kadima et al., 2019). Wakooko et al. (2020) revealed that poor adherence or non-adherence to ART can lead to rapid replication of HIV resulting in the generation of resistant mutant strains, which would no longer be responsive to available antiretroviral drugs. This shows that there is an association of viral suppression with adherence.

In general, it has been observed that patients who were taught by clinicians how to take ART, had better adherence. This demonstrates the importance of the patient–clinician relationship to guarantee a better adherence to ART and underline the importance of health education tools in patient care (Filho et al., 2008).

Regular clinic attendance was generally found to be significantly associated with good adherence to ART and viral suppression (Lokpo et al., 2020; Tanyi et al., 2021). Tanyi et al. (2021) further mentioned that patients who maintained their clinic appointments had issues addressed on time before they became problematic and enjoyed booster adherence and EAC when the need arose. However, Dixon-Umo and Ikpeme (2020) on the other hand found no significant association between viral suppression (<1000 copies/ml) and clinic attendance among adolescents in Nigeria even though ALHIV missed clinic appointments; because sometimes they had their medication collected by parents or family members.

Muri et al. (2017) documented that self-reported suboptimal adherence to ART was associated with VF in children and adolescents in Tanzania. Evans et al. (2013) and Sithole et al. (2018) demonstrated similar findings in their two studies conducted in South Africa and Zimbabwe.

Retention in care (RiC) is defined as the ability to adhere to critical aspects of care, such as attending regular follow up appointments, scheduled laboratory tests and other monitoring activities as prescribed by the healthcare provider (Mukumbang et al., 2017). According to Murray et al. (2017), RiC is a critical precursor to viral suppression as it helps maintain adherence, while not being retained or interruptions to ART increase the risk of drug resistance and mortality. In Uganda and Kenya, the high rate of RiC and full viral suppression (<500 copies/ml) were partly attributable to streamlined care systems addressing domains that predict retention failures such as structural barriers, suboptimal patient-clinician relationships,

and gaps in patient and clinician knowledge that led to stigma and motivation problems (Kwarisiima et al., 2017).

In SA, Van Wyk et al. (2020) found that younger adolescents demonstrated better RiC rates compared with the older group due to the disproportionate attention offered to younger adolescents. Zanoni et al. (2017) indicated that adolescents and young adults attending adolescent-friendly clinics in KwaZulu-Natal had higher RiC and viral suppression (<400 copies/ml) compared to adolescents attending the standard paediatric clinic.

As detailed by Van Wyk et al. (2020), adolescents who were classified as WHO stage I at ART initiation had significantly lower rates of RiC at 4 months post-initiation compared with adolescents who were classified as WHO stage III. This could be that adolescents were not presenting with illness and therefore were doubtful if they were actually living with HIV, and thus less motivated to engage in care. Similarly, Van Wyk et al. (2020) reported that male adolescents on average had greater RiC compared with females. However, other studies reported that males had poor RiC, due to detrimental impact of male gender norms, which inhibited utilization of health services.

Generally, harmful *alcohol use* has been associated with unprotected sexual behaviour and poor ART adherence leading to failure of viral suppression (Mogosetsi et al., 2018). According to Sithole et al. (2018), non-adherence to ART among adolescents is a result of alcohol and substance use, which were associated with VF. They further indicated that alcohol consumption triggered disease progression and failed viral suppression (<1000 copies/ml) (Sithole et al., 2018). Fokam et al. (2019) further reported that male gender norms contributed to alcohol and substance abuse and poorer uptake of health services leading to poorer adherence to treatment and treatment interruption, which favoured treatment failure. Haas et al. (2020) reported that substance use problems were strongly associated with unsuppressed VL (≥400 copies/ml) among adolescents in SA. Contrary to this, Kahana et al. (2016) and Yiltok et al. (2020) found no significant association between viral suppression and problematic substance use or alcohol use.

Disclosure of HIV status is predictive of good clinic attendance and eventually leads to good adherence to ART and viral suppression (Tanyi et al., 2021). Van Wyk et al. (2020) found that adolescents who disclosed their HIV status to a significant other were more likely to be retained

in care at month 12 than adolescents who did not disclose their status to a significant other. Non-disclosure among adolescents was known to be a risk factor for VF (Bernheimer et al., 2015; Sithole et al., 2018). Likewise, Inzaule et al. (2016) stated that delays in disclosure of HIV status to perinatally infected children prior to adolescence lead to non-adherence in Uganda. In Nigeria, disclosure of HIV status predicted better adherence to ART (Ugwu and Eneh, 2013).

2.6 Summary

The reviewed literature presented contradictory findings on factors associated with viral suppression. Some of the literature found an association between age, gender and higher educational levels of the adolescents with viral suppression while others found no association. With regards to clinical factors, the reviewed literature reported associations between low baseline and current CD4 count (<200 cells/µL), WHO stage 4 at ART initiation and having an opportunistic infection with viral non-suppression. Only two studies reported positive associations between having active TB and viral non-suppression. The review of treatment factors suggested that exposure to NVP as an ART regimen or for PMTCT was associated with virologic failure whereas being on a PI-based regimen was associated with better viral suppression. Contradictory findings were presented on the association between duration on ART and viral suppression, as well as other medication with VF. Concerning behavioural factors, good adherence was associated with viral suppression; and likewise sub-optimal and non-adherence was associated with VF. HIV disclosure and having a support structure were associated with better adherence and viral suppression.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter describes the methodology used in conducting the study. It provides a clear definition of the purpose of the study, which was to determine factors associated with viral suppression among adolescents on ART at the Levai Mbatha Community Health Centre (CHC) in the Sedibeng District. It outlines the study objectives and study design followed by a description of the study setting, population and selection criteria for the participants. An overview of the data collection procedure and data sources is presented followed by a description of the methods used to process and analyse the data including an outline of the study variables. The chapter closes with a presentation of the ethical considerations for the study.

3.2 Aim and Objectives

The aim of the study was to determine the factors associated with viral suppression among adolescents aged 10-19 years who were on ART at the Levai Mbatha CHC in the Sedibeng District, Gauteng.

The objectives of the study were as follows:

- To determine the prevalence of viral suppression in adolescents aged 10-19 years after 6 months on ART.
- To determine sociodemographic characteristics associated with viral suppression amongst adolescents.
- To determine clinical characteristics associated with viral suppression amongst adolescents.
- To determine treatment factors associated with viral suppression amongst adolescents.
- To determine behavioural factors associated with viral suppression amongst adolescents.

3.3 Description of the study setting

The study took place at the Levai Mbatha CHC in Evaton Township, Sedibeng District, Gauteng Province. Sedibeng District is located in the southern parts of the Gauteng Province (Fig. 1), and consists of three local municipalities: Emfuleni, Midvaal and Lesedi, of which Emfuleni has the highest population, with more than 700 000 people living in the township areas, especially Sebokeng and Evaton (Massyn et al., 2017; Sedibeng District Municipality,

nd). The Black South African population is the largest in the district at 81%. Seventeen percent of the residents are White, 1% are Indians and 1% are Coloured South Africans (Sedibeng District Municipality, nd)

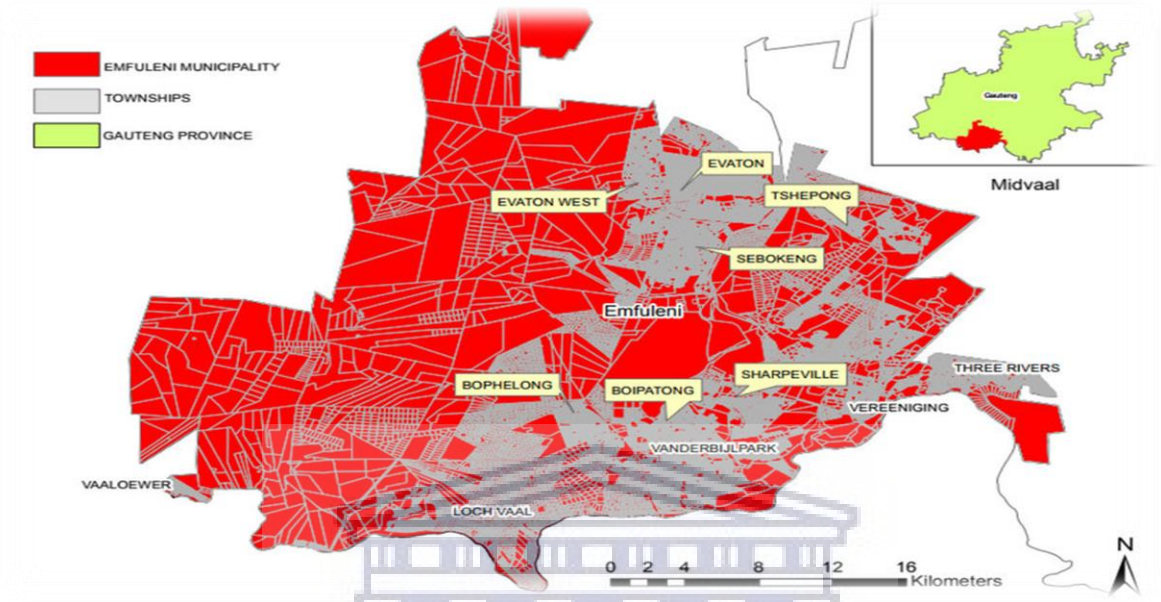

Figure 3.1: Emfuleni local municipality map

The number of public health facilities offering ART services in the Sedibeng District and following the South African ART clinical guidelines for the treatment of eligible adults, adolescents and children over the age of 10 years is presented in Table 3.1 (Pooe, 2021; NDOH, 2020). These health facilities are serviced by the National Health Laboratory Service (NHLS), the largest diagnostic pathology service in South Africa, which provide health laboratory and related public health services to all public healthcare providers (NHLS, nd).

Levai Mbatha CHC is amongst the 42 public healthcare facilities in the Emfuleni local municipality. The CHC renders 24-hour emergency, maternity services and other primary healthcare (PHC) services such as immunisation, primary mental healthcare services, primary oral health services, chronic diseases care, a medical male circumcision program, allied and rehabilitation healthcare services to over 220 000 residents, of whom more than 80% are uninsured and depend on free public PHC (Akinsanyaa et al., 2017; Phukuta and Omole, 2020). The Levai Mbatha CHC is staffed by medical doctors, professional and enrolled nurses and allied health professionals. The health personnel are supported by the family medicine registrars from the University of the Witwatersrand (Akinsanyaa et al., 2017). The CHC was

selected as a study setting mainly because it is a referral facility that provides comprehensive health services to the much larger population in Evaton and Sebokeng (the most densely populated areas in Emfuleni), and it was easily reachable by the primary researcher to collect adolescent data manually since the latest version of the Three Integrated Electronic Register (Tier.Net) could not allow data export into Microsoft Excel.

Table 3.1: Facilities in Sedibeng offering ART services

Facilities	**Emfuleni**	**Midvaal**	**Lesedi**	**Total**
Primary Health clinics	23	5	9	**37**
Health posts	9	0	0	**9**
Mobile Clinics	4	6	2	**12**
Community Health Centre	4	0	0	**4**
District Hospital	1	0	1	**2**
Regional Hospitals	1	0	0	**1**
Total	**42**	**11**	**12**	**65**

3.4 Study design

A retrospective cross-sectional study was conducted using routine records of adolescents who were on ART at the Levai Mbatha CHC. The cross-sectional study was selected as it is relatively faster and inexpensive and allowed selecting routine records based on the inclusion and exclusion criteria, and measured the outcome and exposures in the study participants at the same time (Setia, 2016).

3.5 Study population

The study population comprised of routine records of adolescents 10-19 years who were receiving ART at the Levai Mbatha CHC in the Sedibeng District between January 2015 and December 2018. We included records of adolescents who have received treatment prior 2015 (perinatally-infected adolescents) and those who were started on treatment during the period of the study but had to be on treatment for longer than 6 months.

The study period was selected for the reason that as of 2015, countries were required to report yearly to the UNAIDS on the 90–90–90 targets (Marsh et al., 2019). Therefore our period became crucial to report on adolescent specific data to track progress towards the 2020 targets.

The following criteria were applied in selecting the study population.

Inclusion criteria:

- Routine records of adolescents aged between 10-19 years.
- Routine records of adolescents on ART for 6 months or more since initiation.
- Routine records of adolescents that contain at least one HIV viral load result. The latest recorded viral load result during the study period was considered.

Exclusion criteria:

- Routine records of adolescents who were not in care (had died, loss to follow up) or were transferred to another healthcare facility within 6 months of ART initiation.

3.6 Sample realisation

The minimum sample size was calculated to be **186** using ClinCalc (Kane, 2019) by taking into account the viral suppression rate of one literature study of the same patient population (65.5%); our expected viral suppression rate (75%), alpha of 0.05 and power of 80%. However, all available records of adolescents who were on treatment for the period and met the inclusion criteria were included in the analysis to ensure the study is sufficiently powered (Crossman, 2020).

Records of 382 adolescents attending ART services at the Levai Mbatha CHC were obtained from the Tier.Net. Of the 382 records, 241 records were of adolescents who were in care during the period 2015 to 2018 whilst 141 records were of adolescents who were not on in care during 2015 to 2018. Among the records of adolescents who were in care (241), 8 records were of adolescents who transferred out of the clinic within 6 months of ART initiation and 12 records were of adolescents who were on ART for less than 6 months between 2015 and 2018. Records of 221 adolescents were eligible for inclusion in the study; however, 8 records were of adolescents who had their last VL results available before 2015, 16 records were of adolescents who had no VL results between 2015 and 2018 captured on Tier.Net and in their clinical folders, and 5 records were of adolescents who also had no VL results between 2015 and 2018 captured on Tier.Net and the patients' folders could not be found to track the results for the period of study. Records of 192 adolescents were included in the final analysis.

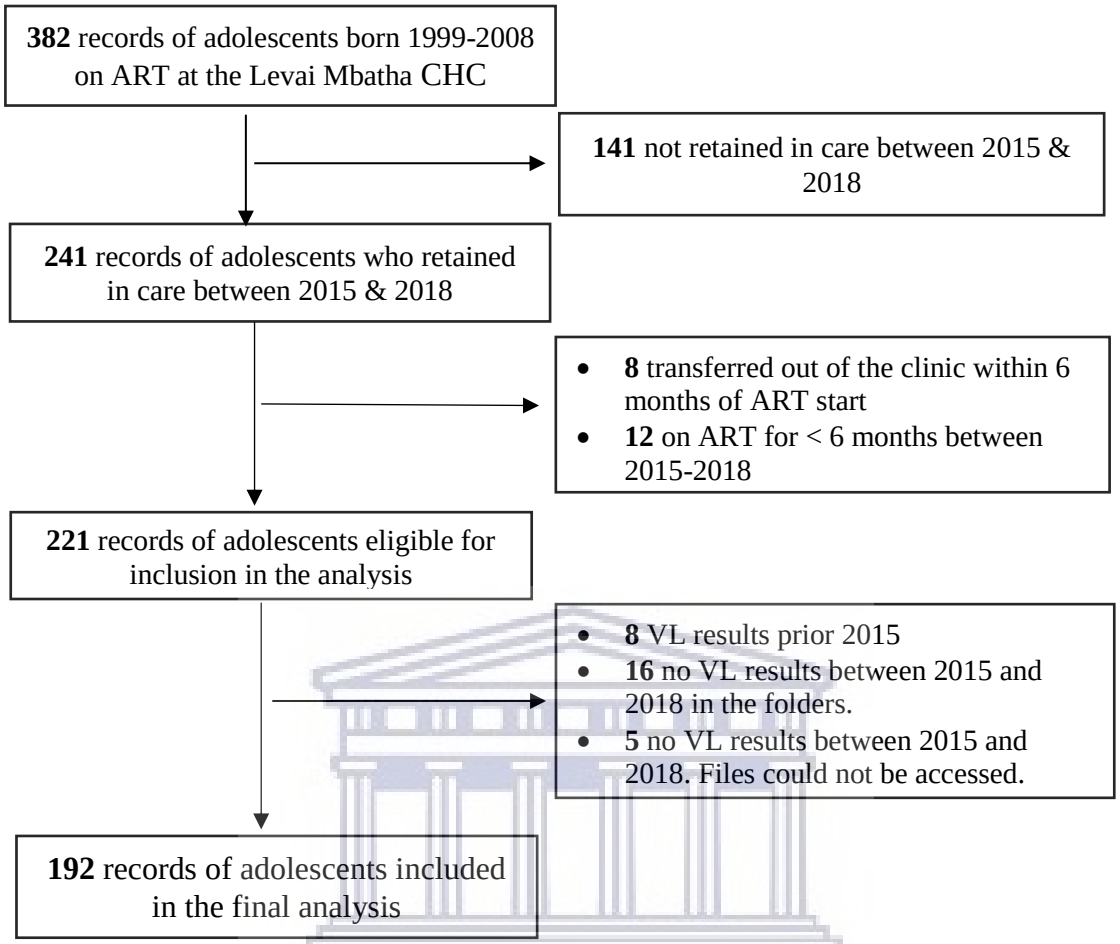

Figure 3.2: Selection of adolescents into the study

3.7 Data collection

The data collection consisted of two parts. In the first part of data collection, the primary researcher engaged the data capturer at the Levai Mbatha CHC to extract adolescent data from the Tier.Net. The Tier.Net was adopted by the National Department of Health in December 2010 to allow for data to be reported centrally (Osler et al., 2014). The three-tier monitoring and evaluation system for ART comprises paper-based, stand-alone electronic, and networked electronic medical record systems for the ART programme (Myburgh et al., 2015). Each tier produces the same nationally required monthly enrolment and quarterly cohort reports so that outputs from the three tiers can be aggregated into a single database at any level of the health system. The system provides programme managers with a better understanding of the burden of care, equity of access, quality of service, retention in care and other outcomes of the programme (Osler et al., 2014). As the updated Tier.Net version 1.13 does not allow for the

export of data into Microsoft Excel, the primary researcher took screenshots of the extracted data and saved the screenshots onto a USB flash drive. Data from the screenshots was further transcribed into an Excel spreadsheet and double-checked for transcription errors. On Tier.Net, we were able to extract data for WHO stage, duration on ART, regimen at ART start, baseline and current CD4 counts, viral load results and gender.

The second part of data collection consisted of the use of a self-developed, standardised data extraction tool (Appendix 1), to collect information from the patient folders. The patient folders comprised of the HIV clinical stationery and other registers or clinic cards.

For *support*, we considered those who supported with the collection of medication while the patients were at school and who accompanied the patients to the clinic. These were referred to as treatment supporters by the clinic.

For *HIV disclosure*, we searched whether the immediate family members, relatives or any other persons (peers or community members) were aware of the patients' HIV status.

For *Adherence* status, the clinicians performed pill counts, checking the number of pills that were given and comparing them to the number of pills remaining at the time of each patient's clinic visit and the patients were interviewed regarding adherence to and times of taking ART medication. The clinicians recorded adherence information on the patient folders for every visit. For this study, we reviewed the clinicians' notes on adherence as documented for each visit for a 12–18-month period to get a better view. Adherence was described as good or poor. For example, if it was documented that a patient was attending clinic visits as required, continuously taking medication at the correct times and patient self-reporting no medication problems, adherence was regarded as good, however, if a patient defaulted on taking medication, missed clinic appointments, self-reporting inconsistencies to medication intake or parent/caregiver reporting poor adherence, then adherence was classified as poor.

For *viral load results*, we extracted the latest viral load captured during the period of the study. Where the viral load result was for the period ahead of 2018, that is 2019 or 2020, we reviewed the patient folders and replaced the result with the latest of the period of the study.

Other variables included on patient folders were alcohol and substance use such as cigarette and/or illegal drugs. For medication other than ART, we reviewed the patient folders for any other medication taken during the period of the study. For education level, we checked on whether the patients were at primary or secondary school, or whether they did not attend school. We regarded the previous history of TB status as TB that was diagnosed before our study period, and TB Treatment at ART start we considered patients that started ART while they were taking TB treatment.

Data that was missing from the Tier.Net was completed using the patient folders. Where data was missing from both the Tier.Net and the patient folders, that data was left out altogether.

3.8 Data analysis

Data was transferred to the Statistical Package for Social Sciences (SPSS) version 27 (IBM Corporation) and coded for each variable. Cross checks were done to compare the coded data to the original Excel spreadsheet data. SPSS was used to compute descriptive and inferential statistics, and Microsoft Office Excel was used to create graphs for the proportions of adolescents with viral suppression and viral non-suppression. The outcome of the study was dichotomised into viral suppression (<1000 copies/ml) and viral non-suppression (≥1000 copies/ml). Characteristics of the study population were described using the frequency tables, with whole numbers and percentages provided. Adolescents' age was stratified into 10-14 years and 15-19 years. CD4 counts were also categorised into less than 350 cells/µL and more than 350 cells/µL. Duration on ART was described as less than 12 months, 13 to 24 months and equal to or greater than 25 months. As the median is not affected by skewed data, both the median and interquartile ranges (IQR) were calculated and described for continuous variables such as age, CD4 count and duration on ART. Support was described and analysed as those supported by family or by others (peers or community members). Educational level was categorised into primary, secondary or no education. WHO staging was also categorised as stage 1 or 2 and 3 or 4. Adherence to ART was described as good or poor, and all other variables such as previous TB history, TB at ART start, other medication, HIV disclosure, alcohol use and substance use were categorised into *Yes* or *No.*

Bivariate analysis was conducted to determine the association between the outcome, viral suppression, and sociodemographic, clinical, treatment and behavioural characteristics. A

Pearson Chi-square ($\chi 2$) test or Fisher's exact test (where cell counts were smaller than five) was performed for categorical variables, and the Mann–Whitney test was performed for continuous variables to determine the statistical significance. Exposure variables that showed a statistically significant association with a p-value of ≤ 0.05 from the bivariate analysis were only described as so, for the reason that the stepwise logistic regression model could not be performed due to the smaller sample size.

3.9 Validity and reliability

Validity refers to measuring what is intended to be measured (Taherdoost, 2016). Standardised HIV clinical stationery is used at the clinic to record the intended clinical and laboratory data and to ensure data validity (NDOH, 2015). Recording of data is done by clinical staff who manage the ART programme and trained data capturers capture the data from the HIV clinical stationery onto the Tier.Net system as part of the ART monitoring and evaluation (NDOH, 2015). Facility file audits are also done to assess gaps and ensure data accuracy (Anova Health Institute, n.d). For this research, a standardised data extraction tool was used to collect data that covered the actual area of investigation. The standardised tool reduced measurement bias by recording similar data from all the patient records. Selection bias was reduced by clearly defining the inclusion and exclusion criteria of the study population.

Reliability is concerned with the repeatability of results. The reliability of the data extraction tool was ensured by using the same data extraction tool on each patient record. Although the data extraction tool was not initially piloted before the actual study, the primary researcher engaged an HIV, AIDS, Sexually Transmitted Infections and TB (HAST) clinician to advice on the variables which can provide reliable measures. Fair adherence was further removed as it would have been difficult to measure consistently.

Data that was obtained from Tier.Net was transcribed onto an Excel spreadsheet by the primary researcher and was checked for duplicates and transcription errors.

3.10 Ethical considerations

Approval of the study for degree purposes was obtained from the University of the Western Cape Higher Degrees Committee, and ethics clearance was obtained from the Biomedical Research Ethics Committee of the University of the Western Cape (Appendix 2). Permission

to conduct the research at the Levai Mbatha CHC and access data records and patient folders was granted by the Sedibeng District Research Committee (Appendix 3).

Informed consent was not sought from the patients as there was no direct contact with them and the District Research Committee waived patient consent following the review of the study protocol as there was no intention to cause physical or psychological harm to the participants, and confidentiality and anonymity was guaranteed. Confidentiality was maintained throughout the study by saving all databases of the study on a password-protected computer. The final data that was used for analysis and reporting was anonymised by removing patient names and folder numbers.

3.11 Summary

This chapter intended to describe the methods that were applied in the study by the researcher. Elements such as study design, setting description, sample and data collections, data analysis, validity and reliability, and ethical considerations were discussed.

The next chapter will present the results of this study under social, clinical, treatment and behavioural factors as the main themes.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter reports on the results of the study. It includes sections that outline the description of the sociodemographic, clinical, treatment and behavioural characteristics of the adolescents in the study, the description of the viral suppression of adolescents as well as the bivariate analysis of viral suppression and characteristics.

4.2 Characteristics of the study participants

Characteristics of the adolescents who were included in the study are described in the sections below. A total of 192 adolescents were included in the study.

4.2.1. Sociodemographic characteristics

The median age of adolescents on ART was 15.0 years (Interquartile Range [IQR] 12.25-17.0). Just more than half of the participants in this study were 15-19 years (n=103; 53.6%) and female (n=105; 54.7%) (Table 4.1).

The median age at ART initiation of adolescents was 9.0 years (IQR 5.0-12.0). More than half (n=109; 57%) of the participants were initiated on ART at ages 0-9 years, whereas 56 (29%) initiated ART at 10-14 years and 27 (14%) initiated ART at 15-19 years.

Only 9 (4.7%) participants had primary or secondary education recorded; and 2 (1%) were recorded as not attending any school. Most (n=181; 94.3%) participants had no educational level recorded (Table 4.1).

The majority of participants (n=144; 75%) had their families as the support structure with treatment collection and clinic visits, while 3 (1.6%) were supported by other people (peers or community members).

Table 4.1: Sociodemographic characteristics of adolescents on ART at the Levai Mbatha CHC (N=192)

		Frequency	Percentage (%)
Age (in years)	10-14	89	46.4
	15-19	103	53.6
Gender	Male	87	45.3
	Female	105	54.7
Education	Primary/Secondary	9	4.7
	No school	2	1.0
	Missing	181	94.3
Support	Family	144	75.0
	Other	3	1.6
	Missing	45	23.4

4.2.2. Clinical characteristics

The median CD4 count at ART initiation was 248 (IQR 98.5 – 423) cells/µL. Of the participants with recorded CD4 count at ART initiation, 87 (45.3%) had CD4 count less than 350 cells/µL, whereas 46 (24%) of the participants had CD4 count greater than 350 cells/µL. Less than a third of participants (n=59; 30.7%) had no CD4 count recorded at ART initiation (Table 4.2).

The median for the current CD4 count was 581 (IQR 380 – 854) cells/µL. Only 6 (3.1%) participants had no current CD4 count recorded on Tier.Net or in their folders. More participants (n=146; 76.1%) had current CD4 count greater than 350 cells/µL, with 40 (20.8%) participants reported current CD4 count of less than 350 cells/µL.

Of those participants (n=157, 81.8%) who had WHO staging recorded at ART initiation, 83 (43.2%) presented with stage III and IV and 74 (38.5%) stage I and II.

We found that only 28 (14.6%) participants had a history of active TB and 56 (29.1%) had no records of previous TB infection.

Table 4.2: Clinical characteristics of adolescents on ART at the Levai Mbatha CHC (N=192)

		Frequency	Percentage (%)
Baseline CD4 count (cells/µL)	<350	87	45.3
	≥350	46	24.0
	Missing	59	30.7
Current CD4 count (cells/µL)	<350	40	20.8
	≥350	146	76.1
	Missing	6	3.1
WHO stage at ART initiation	Stage I/II	74	38.5
	Stage III/IV	83	43.2
	Unknown	35	18.2
History of TB	Yes	28	14.6
	No	108	56.3
	Missing	56	29.1

4.2.3. Treatment characteristics

At ART initiation, only 7 (3.6%) participants were on TB treatment. Of the participants who had other medication recorded, only 4 (2.1%) were found to be taking other medication concurrently with ART (Table 4.3).

The majority of the participants were initiated on an NNRTI-based regimen (n=179; 93.2%), whereas 13 (6.8%) were initiated on a PI-based regimen. Most participants (n=75; 39%) in the study were initiated on *Abacavir, Lamivudine and Efavirenz* (*A3E)* regimen of which 48 (64%) were in the age group 10-14 years, and 37 (19%) participants were initiated on fixed-dose combination regimen *Tenofovir, Emtricitabine/Lamivudine and Efavirenz (TDF, FTC/3TC, and EFV)* of which 33 (89%) were in the age group 15-19 years.

The median duration on ART was 70.5 (IQR 30.25–105.5) months. Most adolescents (n=152; 79.2%) had been on ART for longer than 24 months, while 23 (11.9%) for 13-24 months and 17 (8.9%) for less than 12 months.

Table 4.3: Treatment characteristics of adolescents on ART at the Levai Mbatha CHC (N=192)

		Frequency	Percentage (%)
TB Treatment at ART Start	Yes	7	3.6
	No	112	58.4
	Missing	73	38.0
Other medication	Yes	4	2.1
	No	6	3.1
	Missing	182	94.8
Regimen at ART start	NNRTI-based	179	93.2
	PI-based	13	6.8
Duration on ART (in months)	≤12	17	8.9
	13-24	23	11.9
	≥25	152	79.2

4.2.4. Behavioural characteristics

Most (n=144; 75%) participants with recorded HIV disclosure had disclosed to someone; with 139 (97%) disclosed to a family member, 1 (1%) to a peer and 1 (1%) disclosed to a community member. Three (2%) participants were recorded as disclosed however it was not indicated to whom.

About 75 (52%) participants with HIV status disclosed to someone were in the age group 10-14 years (Table 4.4).

Just more than half of the participants (n=105; 54.7%) were recorded to have good adherence to ART over a period of time, namely, continuously taking medication at the correct times daily and reporting no problems with medication. Sixty (57%) female adolescents reported good adherence compared to male adolescents (n=45; 43%).

Of the participants with alcohol use recorded, only 1 (0.5%) reported drinking alcohol and 29 (15.1%) did not drink alcohol. Of those with substance use recorded, 1 (0.5%) reported using illegal substances and 24 (12.5%) did not use any substances.

Table 4.4: Behavioural characteristics of adolescents on ART at the Levai Mbatha CHC (N=192)

		Frequency	Percentage (%)
HIV disclosure	Yes	144	75.0
	No	2	1.0
	Missing	46	24.0
Adherence	Good	105	54.7
	Poor	52	27.0
	Missing	35	18.2
Alcohol use	Yes	1	0.5
	No	29	15.1
	Missing	162	84.4
Substance use	Yes	1	0.5
	No	24	12.5
	Missing	167	87.0

4.3 Viral suppression amongst adolescents

The proportion of our study participants with viral suppression was 74% (142) (Figure 4.1). The latest viral load result during the period of study was considered to estimate the proportion. The 2019 consolidated guidelines for the management of HIV were revised to reflect a VL count of <50 copies/ml as full viral suppression (NDOH, 2020), and we found that 58 (41%) of our study participants achieved full suppression at the time of the study.

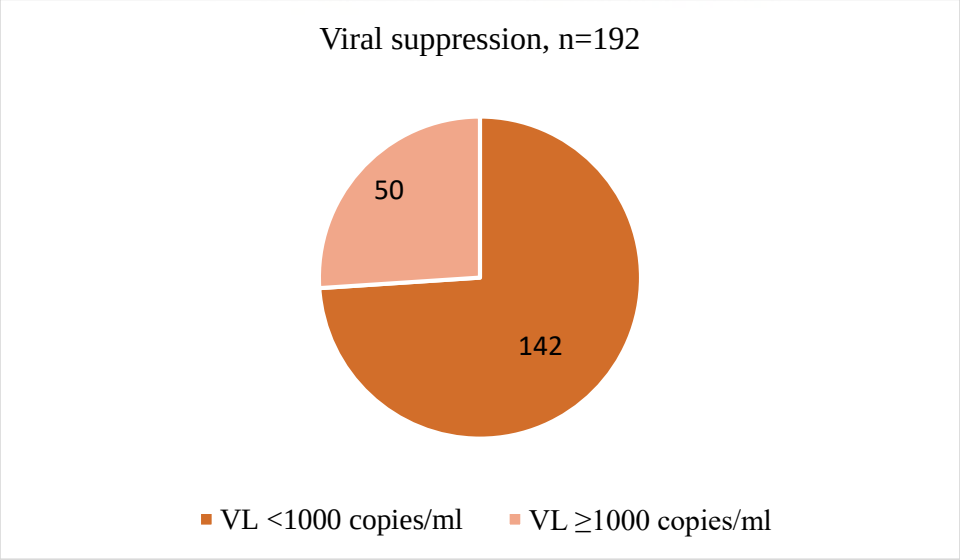

Figure 4.1: Proportion of adolescents with viral suppression at the Levai Mbatha CHC

4.3.1 Sociodemographic characteristics of adolescents with viral suppression

In Table 4.5, older adolescents (15-19 years) had higher viral suppression compared to younger adolescents (10-14 years); however, the difference between the age groups with viral suppression was not statistically significant (*p=0.207*). Female adolescents had higher viral suppression rates compared to male adolescents even though the difference between gender with viral suppression was not statistically significant (*p=0.151*). With regards to education, adolescents who did not go to school had favourable viral suppression rates compared to those who went to school; however, there was no statistically significant difference between education with viral suppression (*p=1.000*). Adolescents who were supported by others (peers or community members) appeared to have the most favourable viral suppression rates; however, the difference between adolescents' support structure with viral suppression was not statistically significant (*p=0.560).*

4.3.2 Clinical characteristics of adolescents with viral suppression

Adolescents who presented with WHO stage III and IV at ART initiation had higher viral suppression rates compared to those who presented with stage I and II; however, there was no statistically significant difference between adolescents' WHO stage at ART initiation with viral suppression (*p=0.435*). Adolescents with history of TB had lower viral suppression rates compared to those with no history of TB; however, the difference between adolescents' history of TB with viral suppression was not statistically significant (*p=0.605*). Adolescents with baseline CD4 count of ≥350 cells/µL also had higher viral suppression rates compared to those with baseline CD4 count of <350 cells/µL even though the difference between baseline CD4 count with viral suppression was not statistically significant (*p=0.249*). Similarly, Adolescents with current CD4 count of ≥350 cells/µL had higher viral suppression rates compared to those with current CD4 count of <350 cells/µL (*p=0.071*).

4.3.3 Treatment characteristics of adolescents with viral suppression

Adolescents who received PI-based regimen had favourable suppression rates than those who received NNRTI-based regimen; however, there was no statistically significant difference between regimen at ART start with viral suppression (*p=0.520*). Similarly, there was no statistically significant difference between other medication taken with viral suppression (*p=0.467*), or TB treatment at ART initiation with viral suppression (*p=0.197*), or duration on ART with viral suppression (*p=0.455*).

4.3.4 Behavioural characteristics of adolescents with viral suppression

There was no statistically significant difference between adolescents' HIV disclosure with viral suppression (*p=0.568*). Similarly, no statistically significant difference was found between alcohol use with viral suppression (*p=1.000*), or substance use with viral suppression (*p=1.000).* However, there was a significant positive association between ART adherence with viral suppression (*< 0.001).* Viral suppression rates were most favourable among adolescents with good adherence to ART compared to those with poor adherence.

Table 4.5 Characteristics of adolescents with viral suppression at the Levai Mbatha CHC

		Viral suppression		*p-value*
		Yes	**No**	
Age (in years)	10-14	62 (69.7%)	27 (30.3%)	*0.207*
	15-19	80 (77.7%)	23 (22.3%)	
Gender	Female	82 (78.1%)	23 (21.9%)	*0.151*
	Male	60 (69.0%)	27 (31.0%)	
Education	Primary/secondary	7 (77.8%)	2 (22.2%)	*1.000*×
	No education	2 (100.0%)	0 (0.0%)	
Support	Family	103 (71.5%)	41 (28.5%)	*0.560* ×
	Other	3 (100%)	0 (0.0%)	
WHO stage at ART initiation	Stage I/II	54 (73.0%)	20 (27.0%)	*0.435*
	Stage III/IV	65 (78.3%)	18 (21.7%)	
History of TB	Yes	19 (70.4%)	8 (29.6%)	*0.605*
	No	82 (75.2%)	27 (24.8%)	
Baseline CD4 count (cells/µL)	<350	62 (71.3%)	25 (28.7%)	*0.249*
	≥350	37 (80.4%)	9 (19.6%)	
Current CD4 count (cells/µL)	<350	25 (62.5%)	15 (37.5%)	*0.071*
	≥350	112 (76.7%)	34 (23.3%)	
TB treatment at ART initiation	Yes	7 (100.0%)	0 (0.0%)	*0.197*×
	No	84 (75.0%)	28 (25.0%)	
Other medication	Yes	4 (100.0%)	0 (0.0%)	*0.467*×
	No	4 (66.7%)	2 (33.3%)	
Duration on ART (months)	≤12	14 (82.4%)	3 (17.6%)	
	13-24	19 (82.6%)	4 (17.4%)	*0.455*×
	≥25	109 (71.7%)	43 (28.3%)	

		Viral suppression		*p-value*
		Yes	**No**	
Regimen at ART start	NNRTI-based	131 (73.2%)	48 (26.8%)	*0.520*×
	PI-based	11 (84.6%)	2 (15.4%)	
HIV disclosure	Yes	105 (73.4%)	38 (26.6%)	*0.568*×
	No	3 (100.0%)	0 (0.0%)	
Adherence	Good	103 (98.1%)	2 (1.9%)	*< 0.001**
	Poor	13 (25.0%)	39 (75.0%)	
Alcohol use	Yes	1 (100.0%)	0 (0.0%)	*1.000*×
	No	25 (86.2%)	4 (13.8%)	
Substance use	Yes	1 (100.0%)	0 (0.0%)	*1.000*×
	No	22 (91.7%)	2 (8.3%)	

**indicates statistical significance*
× *indicates Fisher's Exact test*

4.4 Summary

This chapter presented and described the results of the study. Of the records analysed, we found that only 74% of the adolescents achieved viral suppression (VL <1000 copies/ml) and 41% achieved full suppression (<50 copies/ml). In addition, our bivariate analysis revealed that only adherence was associated with viral suppression.

The next chapter discusses the findings of the research in relation to the existing literature.

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter discusses the factors associated with viral suppression among adolescents on ART at the Levai Mbatha CHC. Our analysis aided in determining the viral suppression rate of adolescents at the Levai Mbatha CHC with the intention of comparing it to that of other regions. The analysis furthermore aided in outlining the factors that are associated with viral suppression at this facility.

5.2 Viral suppression rates among adolescents on ART

The current study found that 74% of adolescents on ART at the Levai Mbatha CHC had viral suppression, which fell short of the UNAIDS target of 90%. Our results are similar to that of studies done in Ehlanzeni District, Mpumalanga (Okonji et al., 2021) and Kenya (Kangethe et al., 2020), which reported viral suppression rates of 74.3% and 74.2% respectively. However, our reported viral suppression rate was much higher compared to a study in Uganda (Natukunda et al., 2019), which reported a viral suppression rate of 65.5% (<1000 copies/ml) among adolescents who received ART for more than 6 months. The rate of viral suppression presented in this study represents the proportion of adolescents known and documented to have VL data available at the healthcare facility for the period of the study. While adolescents without any electronic or paper-based VL records could potentially be virally suppressed, they were presumed to be disengaged from care and thus expected to have unsuppressed viral loads (Haghighat et al., 2021).

5.3 Characteristics of adolescents on HIV treatment

Our study comprised of more female than male adolescents (54.7% vs 45.3%), which was in line with studies done in a health district of the Eastern Cape that reported 55.3% female adolescents (Haghighat et al., 2021) and South Africa's public sector that reported 54% female adolescents (Maskew et al., 2019). The higher proportion of females on ART in our study reflects the higher HIV prevalence among adolescent girls and young women globally (UNAIDS, 2016a).

Our study showed more older adolescents (15-19 years) than younger adolescents (10-14 years) were on ART, similar to a study in the Western Cape (Van Wyk et al., 2020). However, Van

Wyk et al. (2020) found that older adolescents were less likely to be retained in care compared with younger adolescents possibly because of the disproportionate attention offered to younger adolescents. The higher proportion in this study reflects an increase in the number of adolescents aged 15-19 years receiving HIV care and treatment in South Africa (Maskew et al., 2019). Additionally, the high number of adolescents aged 15-19 years is influenced by two factors: the aging of perinatally infected infants who entered HIV care in childhood and an increasing numbers of adolescents aged 15–19 years seeking care for the first time and who were probably infected through sexual transmission (Maskew et al., 2019).

In our study, parents or family members were the main support structure especially for early and middle adolescents, similar to adolescents in Nigeria (Dixon-Umo and Ikpeme, 2020). Different parental "care" approaches possibly supported adherence, this may have included positive parenting (praise and support) and parental supervision/monitoring of adolescent activities (Cluver et al., 2016).

Of the adolescents with records available in our study, the majority (57%) were initiated on ART before 10 years of age (median age of 9 years); 45.3% had baseline CD4 count <350 cells/μL compared to 24% with CD4 count ≥350 cells/μL and 43.2% presented with WHO stages III or IV at ART initiation compared to 38.5% with WHO stages I or II. According to the 2013 WHO guidelines, ART initiation amongst children below 10 years with severe or advanced symptomatic disease (WHO stages III or IV) irrespective of age and CD4 count, or those with CD4 count ≤350 cells/μL irrespective of the of WHO clinical stage should be a priority as there is a great risk of disease progression and death. Several studies have also reported that individuals with low baseline CD4 count and WHO stages III or IV could have delayed HIV diagnosis, which resulted in advanced immune compromise and an increased risk of opportunistic infections compared to individuals with higher baseline CD4 counts and WHO stages I or II. Little is known about the time of HIV diagnosis amongst our children; however we estimate that at the time of diagnosis a significant number of children especially those 5 years and above may have been in a state of moderate immunosuppression and eligible for ART. Even with the eligibility for ART, some children could have been delayed ART initiation.

More adolescents (76.1%) in our study presented with current CD4 counts of ≥350 cells/μL compared to CD4 counts of <350 cells/μL. As reported by the Collaboration of Observational HIV Epidemiological Research in Europe team (COHERE) (2012), patients living with HIV

and having higher CD4 counts were less likely to develop one or more AIDS-defining conditions.

Our study showed that overall 93.2% of adolescents were initiated on an NNRTI-based regimen compared to 78.2% of children under 15 years of age in Kenya (Kadima et al., 2019). The high rate was in accordance with the WHO (2016) antiretroviral guidelines, which recommended the use of NNRTI as a component of first-line ART regimens that is widely implemented in LMICs and PI-based regimens recommended for second-line therapy. The use of the most suitable regimen for adolescents is crucial given the risk of poor adherence and treatment failure and the development of drug resistance amongst this group. In our study we found that 33 (32%) of older adolescents were initiated on TDF+FTC/3TC+EFV fixed-dose regimen and 54% of the younger adolescents were initiated on ABC+3TC+EFV, which was recommended by the South African Department of Health in 2014 as the preferred first-line regimens (NDOH, 2020).

Our study revealed that 79.2% of adolescents were on ART for more than two years and 54.7% of adolescents with available records had good ART adherence whereas Kadima et al. (2019) in their study indicated that 71.5% of the children (0-15 years) were on ART for more than two years of which 95% of the children (0-15 years) reported good ART adherence. The low ART adherence rate in our study could have been attributed to the missing data due to missing patient folders, and also the difference in self-reporting at one point in time and review of clinical notes for a period of 12-18 months. Even with a long duration on ART, the availability of once-daily and single-tablet regimens, adherence may be jeopardised by social and health issues, for example, substance use, poor physical or mental health, unstable housing, poverty, violence, involvement with the criminal justice system and limited social support (Panel on Antiretroviral Therapy and Medical Management of Children Living with HIV, 2021).

Although our data for alcohol and substance use was limited due to poorly documented clinical records and, in some instances the records were not accessible, we found that only 0.5% of adolescents with records available were consuming alcohol and using substances as compared to the 15.1% and 11.5% who were not. This was a positive aspect as The Panel on Antiretroviral Guidelines for Adults and Adolescents (PAGAA) (2021) revealed that the use of alcohol and/or substances has been associated with interruptions in all steps of the HIV care continuum, including lower adherence to ART and increase the risk of TB.

5.4 Sociodemographic characteristics associated with viral suppression

In our study, older adolescents were found to have higher viral suppression compared to young adolescents even though this did not reach statistical significance. The result was consistent with that of a study done in Nigeria by Badejo et al. (2020) who found that among the retained adolescents living with HIV (ALHIV), the viral suppression (<1000 copies/ml) rate was the lowest for young adolescents (47%) compared to older adolescents (78%). Badejo et al. (2020) reported that the likelihood of achieving viral suppression was higher among older adolescents who initiated on TDF+3TC/FTC+EFV regimen. In our study, just over a quarter of older adolescents were initiated predominantly on the TDF+3TC/FTC+EFV regimen, which could have attributed to an increased viral suppression among this group. Similarly, older adolescents achieve viral suppression because they are able to take their ART medication regularly without supervision, that is, they possess self-efficacy and self-competence on ART adherence (Okonji et al., 2021).

There was no statistically significant difference in viral suppression between the male and female adolescents in this study. This was consistent with results from Lokpo et al. (2020), which revealed the lack of association between gender and viral suppression (<1000 copies/ml). A study in the Western Cape; however, showed that males were more likely to achieve viral suppression compared to females (Van Wyk et al., 2020a) and in Kenya, males were likely to be non-suppressed (≥1000 copies/ml) compared to females (Kadima et al., 2019). This variation among gender to viral suppression may be related to gender inequalities experienced by adolescents seeking care.

Support was not significantly associated with viral suppression in this study even though more adolescents were supported by family. Natukunda et al. (2019) also reported family support to be not associated with viral suppression (<1000 copies/ml) in Uganda but further indicated that other studies in LMICs found family support to improve ART adherence and viral outcomes. UNICEF (n.d.) stated that caregivers' knowledge, attitudes and behaviour have a direct impact on adherence, and viral suppression is higher among children whose caregivers receive support from both within and outside the household and whose caregivers express high hopes for their children's health and future.

While our study found education not to be statistically associated with viral suppression, Diress et al. (2020) associated viral suppression (≤ 1000 copies/ml) with education. Carter (2016) reported that lower educational accomplishment was associated with poorer outcomes after starting ART. On the immunological outcomes, he further revealed that the higher the educational level achieved, the higher the CD4 count at ART initiation.

5.5 Clinical characteristics associated with viral suppression

Many adolescents in our study who were initiated on ART at higher WHO stages III and IV appeared to have higher rates of viral suppression compared to those initiated at WHO stages I and II, although this did not reach statistical significance. However, Jobanputra et al. (2015) and Sithole et al. (2018) in their studies found that those who initiated ART at WHO stages III or IV disease were expected to have detectable VL (>100 copies/ml) or VF, which could have been due to delays in ART initiation among adolescents. It was also found that patients initiated on ART after developing AIDS-related illnesses (WHO stage III or IV) had an increased risk of treatment failure as compared to those in WHO stage 1 or II (Chimbetete et al., 2011).

Jobanputra et al. (2015) and Sithole et al. (2018) reported that having an advanced immuno-suppression with CD4<350 cells/µL at ART initiation increased the likelihood of VF. Although WHO guidelines shifted away from using CD4 count to decide when to start ART or monitor treatment efficacy, they considered a decreasing CD4 count as a proxy marker for treatment failure where VL monitoring was not available, and a trigger to switch in ART particularly if the CD4 cell count is <200 cells/µL (Cherutich, et al., 2016). Still, in our study, we found no significant difference between viral suppression and CD4 counts at ART initiation. Similarly, while some studies have reported that current CD4 count >200 cells/µL was associated with viral suppression (<1000 copies/ml) (Okonji et al., 2021), interestingly our study did not show any significant difference between viral suppression and current CD4 count, possibly because of the limited sample size.

In the developing world, many patients either have a history of TB when they initiate ART or develop TB while receiving ART (Komati et al., 2010). A history of TB at baseline is considered a marker for poor health status and it identifies patients that will benefit from ART (Komati et al., 2010). ART may reduce but not eliminate the incidence of subsequent TB episodes (Komati et al., 2010). In our study, we found no association between viral suppression

and a history of TB. However, Kadima et al. (2019) associated a history of TB with viral suppression (<1000 copies/ml) among children ≤ 15 years in Kenya, and Zanoni et al. (2017) associated history of TB with higher retention and viral suppression (<400 copies/ml) rates amongst adolescents attending the adolescent clinic than those attending a standard paediatric clinic.

5.6 Treatment characteristics associated with viral suppression

The majority of the adolescents in our study were initiated on first-line NNRTI-based regimen, Nevirapine (NVP) or Efavirenz (EFV); however, those who were initiated on PI-based regimen had better viral suppression rates. Very few adolescents (6.8%) started on PI-based treatment in this study possibly because it is costly and many healthcare facilities still preferred to start young children (perinatally-infected children) on first-line NNRTI-based regimen and switch them to PI-based regimen in case of treatment failure despite the recommendations to initiate children under 3 years or older children (3-10 years) weighing <10kg on PI-based regimen (Boerma et al., 2017; NDOH, 2015). Fokam et al. (2019) on the other hand reported that patients on TDF+3TC+EFV have the highest virological success compared to those on other first-line (including those that are NVP-based and those containing Zidovudine (AZT) and Abacavir (ABC) as NRTI-backbone) or PI-based regimens. The PAGAA (2021) described EFV as having minimal pharmacokinetic (PK) interaction with Rifamycins, making it an attractive option for patients who require TB treatment. Furthermore, EFV-based regimens have excellent virologic efficacy, including in patients with high HIV RNA (except when EFV is used with ABC/3TC). Muri et al. (2017) in contrast, reported that NNRTI-based regimens were identified as risk factors for VF and the acquisition of HIV drug resistance mutation. They further expanded that sub-therapeutic drug levels in younger children and adolescents because of difficulties to administer the drugs, faster metabolism, differences in pharmacokinetics, and dose-prescribing errors were possibly the reason for this result.

Our study showed higher viral suppression amongst adolescents on ART for 13-24 months (82.6%) and lower viral suppression rate among those on ART for more than 25 months (71.7%); although this did not reach statistical significance. The lack of association between duration on ART and viral suppression in our study was consistent with findings by (Chouraya et al., 2019) who found no association between ART duration with viral suppression or an undetectable VL (<400 copies /ml) in Swaziland; however, our findings were contradictory to

those of Haghighat et al. (2021), who reported that longer duration on ART among adolescents was associated with viral suppression (<1000 copies/ml) and full viral suppression (<50 copies/ml). Okonji et al. (2021) in their study also found that being on ART for 18 to 24 months was a risk factor for viral non-suppression (>1000 copies/ml).

The use of other medication alongside ART in our study was not associated with viral suppression. The finding was comparable to that in Nigeria by Yiltok et al. (2020). However, Sithole et al. (2018) associated other medication with virological failure. This is explained by the pill burden that would be encountered by adolescents taking other medications with ART. Adolescents taking additional non-ART medication daily are less likely to achieve high adherence to ART due to high comorbid status.

5.7 Behavioural characteristics associated with viral suppression

While several other studies have demonstrated that alcohol and/or substance use were associated with the loss of durable viral suppression, relationships, greater time spent with a VL >1,500 copies/ml and low RiC (PAGAA, 2021), our study found no statistically significant association between alcohol and/or substance use and viral suppression. As our data for alcohol and/or substance use was very limited, our results ought to be regarded as descriptive and not as conclusive. Chimbetete et al. (2011) similarly reported no difference in treatment failure among those who were alcohol drinkers possibly because the levels of drinking alcohol in their study had no effect on the drug adherence levels.

Disclosure has been shown to be a protective factor as far as viral suppression is concerned. This could be a result of the association between disclosure of HIV status and adherence. Disclosure of adolescents' HIV status in this study did not show any statistical association with viral suppression. Similarly, Yiltok et al. (2020) found no association in their study, which implied that disclosure was not enough to lead to viral suppression but required the patient to have adequate adherence to ART.

Viral suppression requires effective ART, which implies that the correct dose of appropriate ART is taken consistently and at the correct time interval (Yiltok et al., 2020). Some studies have indicated that adolescents with good adherence to ART were more likely to be virally suppressed compared to those with inadequate or poor adherence. In our study, 98.1% of

adolescents had good adherence, which was strongly associated with viral suppression. This finding was in line with that of Nabukeera–Barungi et al. (2015) who reported 90.4% of adolescents had good adherence. The level of adherence in both the studies was higher than expected for adolescents because when compared with younger children and adults, adolescents living with HIV consistently had higher rates of poor drug adherence and virological failure. Higher levels of adherence are reported to reduce the chances of virological failure, drug resistance, and increase the likelihood of clinical success and positive health outcomes. Disclosure remains a pivotal role in ART adherence as reported in this study. The HIV status of participants in our study was known by supportive family members. Van Wyk and Davids (2019) also revealed that improved adherence was observed amongst adolescents whose HIV status has been disclosed to them.

Some studies have established 95% adherence levels by pill counts only among adolescents (Nabukeera–Barungi et al., 2015). In our study, adherence may have been higher because clinical records were used to assess adherence. Adherence assessment was made by the clinicians during their routine clinical practice. To note, most ART-servicing facilities are always occupied, and clinicians may not be in a position to precisely assess adherence by counting pill balances from all patients. In addition, studies have shown that the pill count method of adherence assessment can be manipulated, and adherence has been found to differ with the method of assessment used (Nabukeera–Barungi et al., 2015).

5.8 Limitations of the study

The use of a retrospective cross-sectional study design meant that the study could not allow causality to be established since exposure and outcome are measured at the same time. Similarly, we had to rely on the accuracy and completeness of documentation in patients' clinical folders and the Tier.Net system by the administration clerks, data capturers and clinicians. The sample size was constricted, which limited the ability to conduct multivariate logistic regression and could have potentially influenced the findings.

The major limitation of this study was missing data, which could have resulted in missing data bias. Missing data from patient clinical folders included but was not limited to incorrect documentation, incomplete folders, duplicate folders and missing clinical folders.

Incorrect documentation

Although clinicians considered proper documentation essential for nursing professionalism, they still found this secondary task to be burdensome. This was evident from the incorrect documentation witnessed, which proved to be an obstacle to obtaining the required data for the study. Our final database had a substantial amount of missing data, for instance, with reference to education, primary or secondary school attendance was not specified.

Incomplete folders

Another hindrance in obtaining data was incomplete patient folders, where some of the data required for the study was not recorded. Okaisu et al. (2014) in their study concluded that recording consumes up to 50% of the clinicians' time per shift even though it serves several important functions, such as communication amongst clinicians for continuity of care, and is essential for the provision of safe and effective care and protection of accountability of clinicians who delivered that care.

Duplicate folders

According to McCoy et al. (2013), duplicate folders exist when a single patient has more than one clinical folder, and this creates a problem as clinicians could easily miss important information that exists in a folder different from the one that was accessed. In agreement with McCoy et al. (2013), we also experienced the same predicament during our data collection where we obtained recent clinical folders and old folders could not be accessed, which limited our required data. Upon enquiry on the whereabouts of the old clinical folders, the administrative clerks cited that they were in the process of locating and combining all the duplicate clinical folders into one.

Missing clinical folders

Some of the patients' clinical folders could not be accessed altogether during data collection. This constricted our data to a great extent. Upon enquiry on the reasons for missing clinical folders, the following were cited by the administration clerks:

- There is a possibility of misfiling on the overloaded shelves.
- The patient could have left the folder in some other area within the facility.
- The patient could have removed the record from the facility.

In instances where the latter two reasons are concerned, the National Guideline for Filing, Archiving and Disposal of Patient Records in Primary Healthcare Facilities should be followed at all times. The guideline clearly stipulates that the patient must be contacted to explain exactly the location of the clinical folder, or if the patient is unable to return the clinical folder within one day or does not return it at all after agreeing to do so, arrangements must be made with the ward-based outreach team (WBOT) member responsible for the area where the patient resides to retrieve the clinical folder from the patient's home and return it to the facility (NDOH, 2017).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Viral suppression among adolescents on ART was relatively high in this study in comparison to some regions, but it was still below the target of 90%. Adherence was the only factor associated with the achievement of viral suppression in this study, with more than 90% of adolescents having good adherence. The results highlighted the importance of good ART adherence in improving the viral suppression rate, regardless of the age, gender, duration of ART and ART regimen the adolescent is on. Adherence is particularly critical for viral suppression as over the long term it can be challenging even for the most motivated adolescents.

Various studies have reported that generally patients who disclosed their HIV status were able to take ART more easily. In this study, it is possible that knowledge of adolescents' HIV status by others could have had a significant effect on ART adherence. Adolescents may have been encouraged to take medication regularly, and an increased responsibility may have been placed among older adolescents in taking the medication regularly without supervision.
Knowledge of adolescents' HIV status in this study may have also paved a way for building strong support systems among family. As young adolescents may not be mature enough to manage treatment and care commitments on their own, they need guidance and support to strengthen adherence. Strong family support for adolescents in this study may have impacted positively on the ability to adhere to ART.

6.2 Recommendations

The recommendations that follow are aimed at informing programmatic approaches to adolescent HIV treatment and improving the viral suppression rate.

- As the study demonstrated that ART adherence was strongly associated with viral suppression, factors contributing to adherence challenges must be assessed regularly among adolescents. Patients who are having difficulties with adhering to appointments or ART should be approached in a positive, non-judgemental and problem-solving manner, and directly observed therapy may also be considered as recommended by the Panel on Antiretroviral Therapy and Medical Management of Children Living with HIV (2021).
- Alcohol and substance use have been reported to impact negatively on persons on ART as it can lead to medication defaulting and an increase in the risk of liver problems (Pebody,

2021); therefore, it may be advisable for a CAGE Adapted to Include Drugs (CAGE-AID) screening tool to be incorporated into the routine clinical care of all adolescents on HIV treatment (Haas et al., 2020).

- Monitoring and Evaluation (M&E) specifically for adolescents on ART is fundamental just as it is for children (<14 years) and adults. M&E should be carried out to improve retention in care and treatment outcomes. The HIV programme needs to develop adolescent-specific indicators and outcome measures, which would assist in identifying the challenges to reaching the goal of viral suppression.
- Adolescents' individual needs and preferences should be considered when making decisions about the ART regimen to be taken. The PAGAA (2021) highlighted that adolescents experience too many challenges with complex regimens and also do not want to be different from peers; therefore simple regimens are the most preferred for them.
- Health literacy on the benefits of ART should be considered especially for asymptomatic adolescents as it is associated with better adherence to ART (PAGAA, 2021).

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APPENDICES

Appendix 1: Data collection tool

Tool no. _____	Unique ID _____
Facility name _____	Folder no. _____
Name(s) _____	
SOCIODEMOGRAPHIC INFORMATION	
Gender: Male: _____	Female: _____
Date of Birth: _____	
Education, *please tick*	
Primary	☐
Secondary	☐
No education	☐
Blank	☐
Support, *please tick*	
Family	☐
Peers	☐
Community	☐
Blank	☐
CLINICAL INFORMATION	
Age at ART start date: _____	
Baseline CD4 count result: _____	
Current CD4 count result: _____	
HIV Viral load result: _____	
Initial WHO Clinical Stage, *please tick*	
Stage I	☐
Stage II	☐
Stage III	☐
Stage IV	☐
Unknown	☐
ART Regimen at Initiation, *please tick*	
Tenofovir+ Emtricitabine+ Efavirenz (TFE)	☐
Tenofovir+ Emtricitabine+ Nevaripine (TFN)	☐
Tenofovir+ Lamivudine+ Efavirenz (T3E)	☐
Tenofovir+ Lamivudine+ Nevaripine (T3N)	☐
Tenofovir+ Lamivudine+ Lopinavir/ritonavir (T3L)	☐
Stavudine+ Lamivudine+ Efavirenz (S3E)	☐
Stavudine+ Lamivudine+ Nevaripine (S3N)	☐
Stavudine+ Lamivudine+ Lopinavir/ritonavir (S3L)	☐
Zidovudine+ Lamivudine+ Nevaripine (Z3N)	☐

Zidovudine+ Lamivudine+ Efavirenz (Z3E)	☐
Zidovudine+ Lamivudine+ Lopinavir/ritonavir (Z3L)	☐
Zidovudine+ Didanosine+ Lopinavir/ritonavir (ZdL)	☐
Abacavir+ Lamivudine+ Efavirenz (A3E)	☐
Abacavir+ Lamivudine+ Nevaripine (A3N)	☐
Abacavir+ Lamivudine+ Lopinavir/ritonavir (A3L)	☐
Other	☐
Blank	☐
Duration on ART*, please tick*	
<12 months	☐
13-24 months	☐
>25 month	☐
Other medication, *please tick*	
Yes	☐
No	☐
Blank	☐
Previous History of TB*, please tick*	
Yes	☐
No	☐
Blank	☐
TB Treatment at ART Start*, please tick*	
Yes	☐
No	☐
Blank	☐
BEHAVIOURAL INFORMATION	
Adherence, *please tick*	
Good	☐
Poor	☐
Blank	☐
HIV disclosure, *please tick*	
Yes	☐
No	☐
Blank	☐
Alcohol use, *please tick*	
Yes	☐
No	☐
Blank	☐
Substance abuse, *please tick*	
Yes	☐
No	☐
Blank	☐

Appendix 2: Ethics Approval

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

14 December 2020

Ms SE Mabizela
School of Public Health
Faculty of Community and Health Sciences

Ethics Reference Number: BM18/5/14

Project Title: Determinants of viral suppression among adolescents on antiretroviral therapy in the Sedibeng District, Gauteng province

Approval Period: 14 December 2020 – 14 December 2023

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report annually by 30 November for the duration of the project.

Permission to conduct the study must be submitted to BMREC for record-keeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: BMREC-130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 3: Sedibeng Research Committee approval letter

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Ms. N. Tuswa
Tel: 016 950 6255
Email: Nomonde.Tuswa@gauteng.gov.za

TO : **MS. SIBONGILE MABIZELA**
UNIVERSITY OF WESTERN CAPE

FROM : **MR. T. MAGORO**
ACTING CHIEF DIRECTOR: SEDIBENG DISTRICT HEALTH SERVICES

DATE : **03 NOVEMBER 2021**

SUBJECT: **DETERMINANTS OF VIRAL SUPPRESSION AMONG ADOLESCENTS ON ANTIRETROVIRAL THERAPY IN SEDIBENG DISTRICT, GAUTENG PROVINCE**

Please be informed that permission has been granted for you to carry out the above-mentioned research at Levai Mbatha CHC. It is noted that you have already obtained Provincial Ethics Committee as well as Research Ethics Clearance from University of Western Cape.

Kindly note that a copy of the report on the findings (especially) that concerns Sedibeng District should be submitted to the Chief Director's office at the completion of the study.

This permission is also subject to the conditions stated in the protocol and any change in design and methodology must be communicated to the Chief Director.

We wish you success in your research endeavours.

RECOMMENDED / NOT RECOMMENDED / RECOMMENDED AS AMENDED

PROF. B. OMOLE
CHAIRPERSON: SEDIBENG RESEARCH COMMITTEE

APPROVED / NOT APPROVED / APPROVED AS AMENDED

MR. T. MAGORO
ACTING CHIEF DIRECTOR: SEDIBENG DISTRICT HEALTH SERVICES

RESEARCH PROPOSAL DETAILS: GP_202101_007

Sedibeng DHS, Cnr Frikkie Meyer & Pasteur Blvd, Private Bag X 023, Vanderbijlpark