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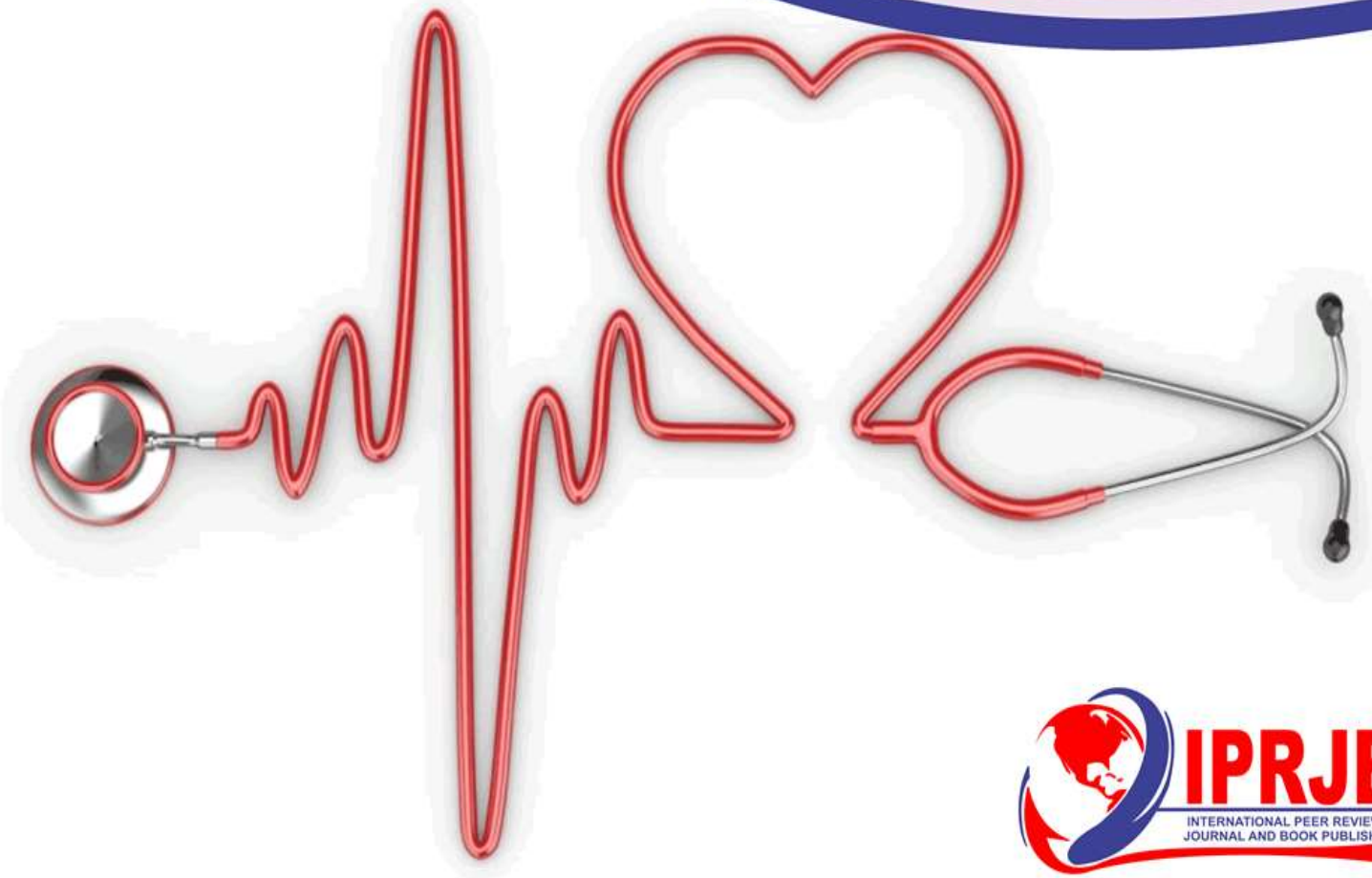

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Factors Influencing Adherence to Combined Antiretroviral Therapy among HIV-Infected Adolescents in Machakos County, Kenya

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Abstract

Purpose: This study investigated factors influencing adherence to combined antiretroviral therapy (cART) among HIV-infected adolescents in Machakos County, Kenya.

Methodology: The study applied a mixed-methods approach. Quantitative data from structured questionnaires and medical records, along with qualitative data from key informant interviews, were analyzed to understand the impact of stigma/discrimination, healthcare factors, social support, and socio-demographic characteristics on adolescents' adherence to cART.

Findings: The study found that reliable availability of antiretroviral drugs, caregiver support, and a supportive healthcare environment were crucial for maintaining treatment regimens. Financial barriers, transportation costs, and system failures were identified as challenges to adherence. Inferential statistical analysis revealed significant factors affecting adherence: frequency of clinic visits, time to receive medication, and treatment by staff. Frequency of clinic visits showed a negative correlation with adherence probability, indicating that more frequent visits were associated with higher adherence. Surprisingly, a longer time spent at the clinic was positively correlated with adherence, suggesting that more time spent at the clinic may reflect more comprehensive care. Poor treatment by staff negatively impacted adherence highlighting the need for better patient-staff interactions. Social support was also crucial, with 82.8% of respondents having someone accompany them to appointments, 89.4% having support to remember medication, and 97.6% receiving support from the clinic. Most social support came from family members (63.3%), followed by hospital staff (59.5%), with notable dissatisfaction from community (26.8%) and friends (26.8%). Demographic factors, such as age, level of education, living with extended family, and ART regimen, also influenced adherence. Age was negatively associated with adherence, with each additional year decreasing adherence likelihood by 4%. Primary education completion was linked to an 81% higher chance of non-adherence. Living with extended family positively influenced adherence increasing it by 23%. The ART regimen TDF/3TC/DTG was associated with a 28% decrease in adherence compared to ABC/3TC/LPV/r.

Unique Contribution to Theory, Practice and Policy: Recommendations include enhancing support systems, improving healthcare experiences, tailoring interventions, and optimizing clinic visits to address these barriers. In conclusion, addressing determinants such as demographic, clinical, social, and healthcare-related factors can lead to targeted interventions that enhance adherence rates and improve health outcomes for HIV-infected adolescents. The study's findings provide valuable insights for healthcare providers and policymakers to develop strategies that support this vulnerable population in Machakos County and beyond.

Keywords: *Adherence, Stigma, Discrimination, Viral Suppression and Antiretroviral Therapy*

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INTRODUCTION

Adolescents account for a significant proportion of new HIV infections globally, with sub-Saharan Africa bearing the highest burden. In Kenya, approximately 110,000 adolescents live with HIV, yet only 40% achieve viral suppression (UNAIDS, 2022). Adherence to ART is critical for viral suppression, yet adolescents face unique challenges compared to other age groups. These include stigma, poor social support, and developmental factors that affect their ability to adhere to treatment regimens

Globally, The World Health Organization (WHO) estimates that only 63% of adolescents living with HIV are receiving antiretroviral therapy (ART). This is significantly lower than the global average of 80% among all age groups (Chirambo et al., 2019). In Machakos county a study conducted by the Kenya National AIDS and STI Control Programme (NASCOP) in 2017, the prevalence of HIV among adolescents aged 15-19 in the County was estimated to be 2.2%, which is higher than the national average of 1.6% (NASCOP, 2017). In a separate NASCOP (2018) study revealed that approximately 8.3% of people living with HIV (PLWH) were adolescents aged 10-19 years old.in the County.

In Africa, the adherence rate to antiretroviral therapy (ART) among adolescents is estimated at around 70%. This is slightly higher than the global average but still represents a significant gap (Nigusso & Mavhandu-Mudzusi, 2020). Lastly, In Kenya, adherence to antiretroviral therapy (ART) among adolescents is estimated to be around 77% This is slightly higher than the global and regional averages but still represents a significant gap to the desired 100% rate, which goes a long way in helping people infected with HIV/AIDS (Mukui et al., 2016. According to a study conducted by the Kenya National Bureau of Statistics (KNBS) in 2019, the cART uptake among adolescents in Machakos county was estimated to be at 33.2%. (KNBS, 2019).) This is lower than the national estimates which implies a lot of gaps which need to be identified.

Problem Statement

Despite interventions aimed at improving ART adherence, many adolescents in Kenya fail to achieve the recommended 95% adherence threshold. This study focuses on Machakos County, a region with significant healthcare challenges and socio-economic barriers that impact adolescent adherence to ART.

Adolescents are more vulnerable to HIV infections due to a lack of effective preventive measures when engaging in sexual activities. Research on adolescents' sexual behaviour (Aarø *et al.,* 2014) has shown that a range of factors, including a lack of sexual reproductive health and HIV/AIDS information and services, contribute to a heightened risk of HIV among young people in Kenya

Most existing initiatives focus on educating adolescents about the preventive measures for avoiding HIV infections and rarely confront the challenges of managing HIV infections among the already infected adolescents (Kamau *et al.*, 2012).

Research shows that a near-perfect (>95%) adherence is necessary to achieve full and durable viral suppression (Paterson *et al.*, 2000; Machtinger & Bangsberg, 2006). However, adolescents could be more prone to non-adherence to cART(Gill *et al.*, 2005). Therefore, adolescents are at high risk of developing treatment failure and drug resistance, requiring special attention in adhering to cART (Ball, 2010).

Objectives

The broad objective was to explore the determinants of ART adherence among adolescents in Machakos County, Kenya. Specific objectives included:

1. Analyzing patterns of adherence.
2. Identifying clinical predictors of adherence.
3. Examining the impact of stigma on adherence.
4. Assessing the role of social support in adherence.

LITERATURE REVIEW

Introduction

HIV/AIDS remains a significant global health challenge, profoundly affecting immune function. Once the immune system gets depressed, patients have increased vulnerability to opportunistic infections that are usually uncommon in individuals with an intact immune system (Bairagi & Adak, 2014).

HIV transmission primarily occurs through unprotected sexual contact (Ndongo & Hamad, 2014), but prevention mechanisms such as antiretroviral treatment (ART), encouraging safe sex and abstinence have significantly reduced rate of infection and disease progression (Bairagi & Adak, 2014). However, HIV prevalence among adolescents remains alarming, particularly in Sub-Saharan Africa, where societal and behavioural factors amplify risks.

About 36 million deaths globally in 2012 were attributed to HIV (Campsmith *et al.*, 2010). WHO (2013) estimated that up to 1.5 million people died of HIV infection around the world (Campsmith *et al.*, 2010).

Prevalence of HIV among youths and adolescents in sub Saharan countries is high (Aarø *et al.*, 2014; Juma *et al.*, 2014). 45% of the individuals contracting HIV globally were young people between 15 and 24 years (Council, 2015). Adolescence is a critical stage of human development Individuals reach sexual maturity, and manifested in sexual engagement among a high percentage of adolescents (Njue, Voeten, and Ahlberg, 2011) informed mainly by peer pressure and curiosity that that increase the possibility of contracting sexually transmitted infections, including HIV. Ball (2010) . S

HIV/AIDs among Kenyan Adolescents

Adolescents in Kenya, especially young women, are at a higher risk of HIV infection due to early sexual activity, low contraceptive use (e.g. condoms), and inadequate reproductive health education. Mukui et al., 2016 suggest that 77% of adolescents in Kenya are compliant with antiretroviral treatment (ART). Despite interventions, challenges like stigma, limited preventive education, and gender disparities exacerbate the crisis. Research indicates that only a small percentage of adolescent females use condoms compared to their male counterparts, highlighting a critical gap in protective behavior (Kamau *et al.*, 2012).

Antiretroviral Treatment Challenges among HIV-Infected Adolescents

HIV-infected adolescents face significant challenges adhering to ART, including stigma, delayed disclosure, and emotional effects like depression. Growth delays and psychological issues such as lipodystrophy further complicate adherence. Poor adherence often leads to virological failure and resistance to treatment, underlining the necessity of targeted interventions (Aaron & Levine, 2005; Tenkorang & Maticka-Tyndale, 2014).

HIV Management Outcome among Adolescents

ART among HIV infected persons aims to suppress viral replication and enhance immune recovery, but adolescent adherence rates remain suboptimal compared to adults (Flynn *et al.*, 2004). Factors influencing adherence include socio-cultural barriers, economic constraints, and inadequate healthcare support. Adherence has been linked to knowledge gaps, stigma, and poor healthcare infrastructure (Agwu *et al.*, 2017).

Adherence to Antiretroviral Treatment

High adherence is defined as taking over 95% of doses (WHO, 2007). It is determined by the extent that patients change their behaviour to comply with the rules and guidelines of healthcare providers. Near-perfect (>95%) adherence is necessary to achieve full and durable viral suppression (Machtinger & Bangsberg, 2006; Paterson *et al.*, 2000). Adherence is intended to reduce HIV-related morbidity and mortality by reducing the viral load, increasing the CD4 cell count, as well as reducing resistance to drugs (Machtinger & Bangsberg, 2006).

Key determinants of ART adherence include:

Stigma and Socio-Cultural Perceptions: Negative societal attitudes and traditional beliefs hinder acceptance and adherence to ART(Juma *et al.*, 2014). Stigma leads to social isolation, reluctance to seek treatment, and inconsistent medication use Kimera et al., 2020; Zanoni et al., 2022

Adverse Drug Reactions: ART's adverse side effects impact individuals' quality of life and medication adherence (Gelaw *et al.*, 2018). Side effects like fatigue and headaches discourage continued use of medication. Improved education on managing side effects is essential to adherence.

Healthcare Setting: Clinical setting provides much-needed social support from healthcare providers (Machtinger & Bangsberg, 2006). Challenges like long waiting times, limited resources, and lack of trust in healthcare providers deter adherence. The perception that healthcare providers are warm and caring towards people living with HIV is associated with improved adherence (Jani, 2016). Enhanced patient-provider relationships and efficient systems are critical.

Social Support: Family and community support significantly impact adherence, with active involvement in care regimens improving treatment consistency (Li et al., 2021; Butler et al., 2023). Family is an important institution for building relationships. Social support was also shown as a major coping strategy to adverse reactions to ART by HIV-infected individuals; this helps them continue taking the drugs, thus lowering non-adherence (Gelaw *et al.*, 2018).

Co-Morbidities: Treating co-infections and simplifying treatment regimens improve adherence (Waudo, 2012). but costs often remain a barrier ART (Mbuagbaw *et al.*, 2012). The presence of chronic diseases is negatively associated with adherence. Opportunistic infections increased adherence rates since they perceived their illness as severe and sought treatment (Peña *et al.*, 2014)

Gaps and Recommendations

Research in Kenya highlights the need for targeted studies addressing ART adherence among adolescents, particularly in underrepresented regions like Machakos County. Enhanced education initiatives, improved healthcare access, and stigma reduction strategies are pivotal to combating HIV among adolescents.

METHODOLOGY

This study employed a cross-sectional research design, incorporating both quantitative and qualitative approaches to investigate factors influencing adherence to combined antiretroviral therapy (cART) among HIV-infected adolescents in Machakos County, Kenya. The use of a mixed-methods approach enabled a comprehensive understanding of adherence behaviors, aligning with contemporary research practices that advocate for integrative methodologies to capture both numerical data and contextual insights (Creswell & Creswell, 2018). The target population comprised HIV-infected adolescents aged 10 to 19 years attending the Machakos Level 5 Hospital Comprehensive Care Centre (CCC). Healthcare workers involved in adolescent HIV care were also included as key informants.

A sample size of 175 adolescents was determined using Yamane's (1967) formula with a 95% confidence level and a 5% margin of error. Participants were selected through simple random sampling to minimize selection bias and ensure a representative sample. Inclusion criteria included HIV-infected adolescents aged 10 to 19 years accessing cART at Machakos Level 5 Hospital CCC for at least one year, willingness to provide informed consent or assent, and healthcare workers with direct involvement in adolescent HIV care. Exclusion criteria included adolescents too ill to participate and individuals unwilling to provide consent or assent. Data were collected using structured questionnaires, key informant interviews (KII), and medical records reviews. The structured questionnaire covered demographic data, social support factors, stigma levels, adverse drug reactions, and healthcare access challenges.

The Pills Identification Test (PIT) and Visual Analogue Scale (VAS) were employed to assess adherence to antiretroviral therapy, consistent with protocols outlined by Parienti et al. (2001). A pilot test was conducted at Kitui County Referral Hospital to validate and assess the reliability of the data collection instruments. Fifteen adolescents and two healthcare workers participated in the pilot phase, which facilitated adjustments to the tools for clarity and precision. Internal consistency was evaluated using Cronbach's alpha, with a threshold of 0.7 indicating acceptable reliability (Tavakol & Dennick, 2011).

Quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) version 29. Descriptive statistics, including frequencies, means, and standard deviations, were used to summarize the data. Inferential analysis, such as chi-square tests and logistic regression, identified relationships between independent variables (e.g., stigma, social support) and adherence levels. Qualitative data from KIIs were transcribed, coded, and thematically analyzed using NVivo software to contextualize quantitative findings (Merriam & Tisdell, 2016). Ethical approval was obtained from the Kenya Medical Research Institute (KEMRI) Scientific and Ethics Review Unit (SERU). Informed consent was secured from participants aged 18 and above, while assent was obtained from adolescents below 18, with guardian consent where applicable. Confidentiality was maintained through data anonymization, secure storage, and restricted access to research records, adhering to the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2013).

FINDINGS

Demographic Characteristics and Basic Statistics

The study involved 169 adolescents living with HIV/AIDS, with an average age of 16.38 years. The sample had a nearly equal gender distribution 49% male and 51% female. Most participants were unmarried (97.6%), and a significant proportion (46.6%) had attained

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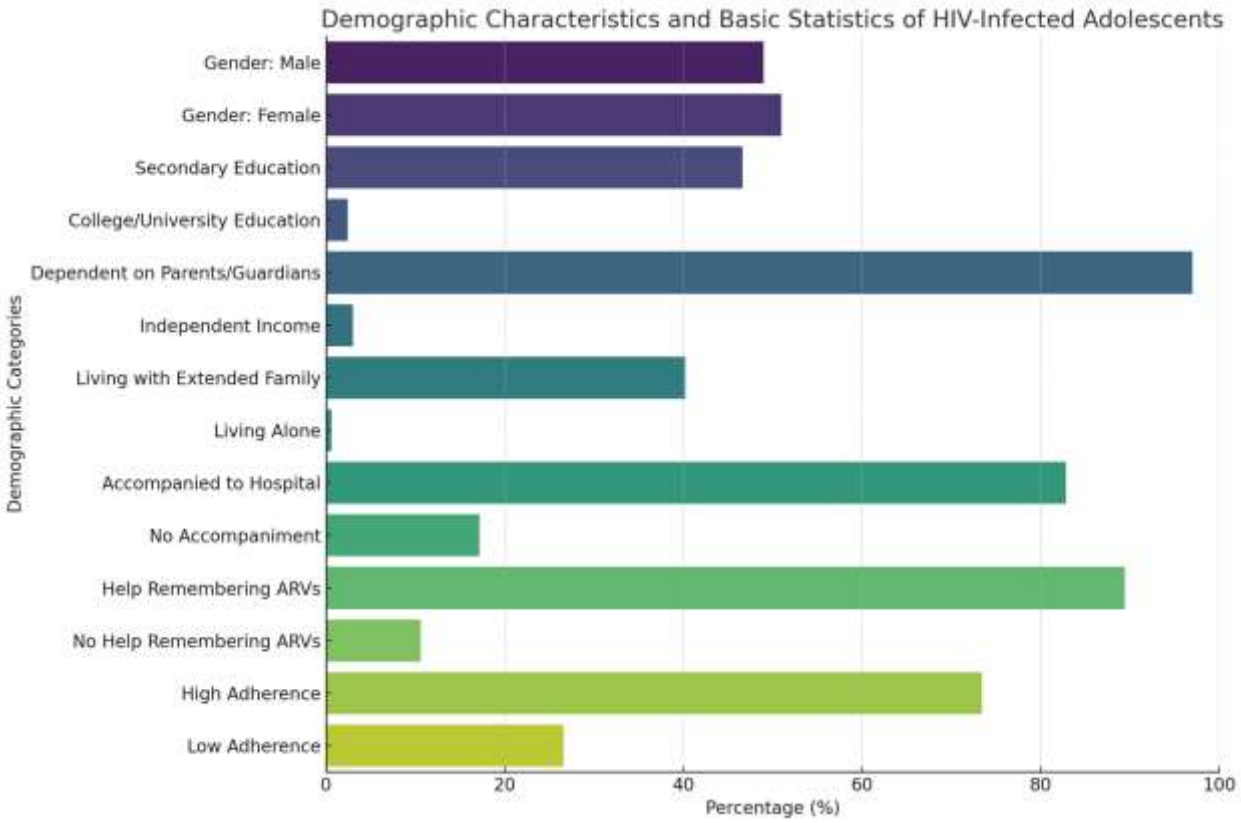
ISSN 2520-4025 (Online)
Vol.11, Issue 1. No.5, pp 69 – 83, 2025
www.iprjb.org

secondary education, while only 2.4% had completed college or university. Parental support was the primary source of income for 97% of respondents. Living arrangements varied, with 40.2% residing with extended family, 32% with both parents and siblings, and only 0.6% living alone. The majority (82.8%) had someone to accompany them to hospital appointments, and 89.4% had assistance remembering to take antiretroviral (ARV) drugs. Adherence rates were high, with 73.4% of participants classified as having high adherence, and only 2.4% reported missing doses in the past four days. Most respondents (71.6%) were on the TDF/3TC/DTG medication regimen.



Determinants of Treatment Adherence

The multivariate probit analysis revealed that **age** is a significant factor in ART adherence, with older adolescents showing a marked decrease in their likelihood to adhere to treatment (p=0.000). This could be attributed to increased autonomy as adolescents age, leading to less oversight from caregivers and greater susceptibility to peer influence or stigma, which may discourage consistent medication use. **Education level** also played a crucial role; adolescents with only primary education had significantly lower adherence rates (p=0.005). This may reflect limited health literacy or understanding of the importance of consistent ART adherence. **Marital status** further influenced adherence negatively, with married adolescents less likely to follow their treatment regimens (p=0.035). The added responsibilities of marriage, potential household duties, or even partner-related stigma could contribute to this trend.

Conversely, **living with extended family** positively impacted adherence (p=0.002), underscoring the importance of supportive family structures in promoting health behaviors. Extended family members may provide emotional support, reminders for medication, or even financial assistance for clinic visits, which collectively enhance adherence. **The type of ART**

Journal of Health, Medicine and Nursing
ISSN 2520-4025 (Online)
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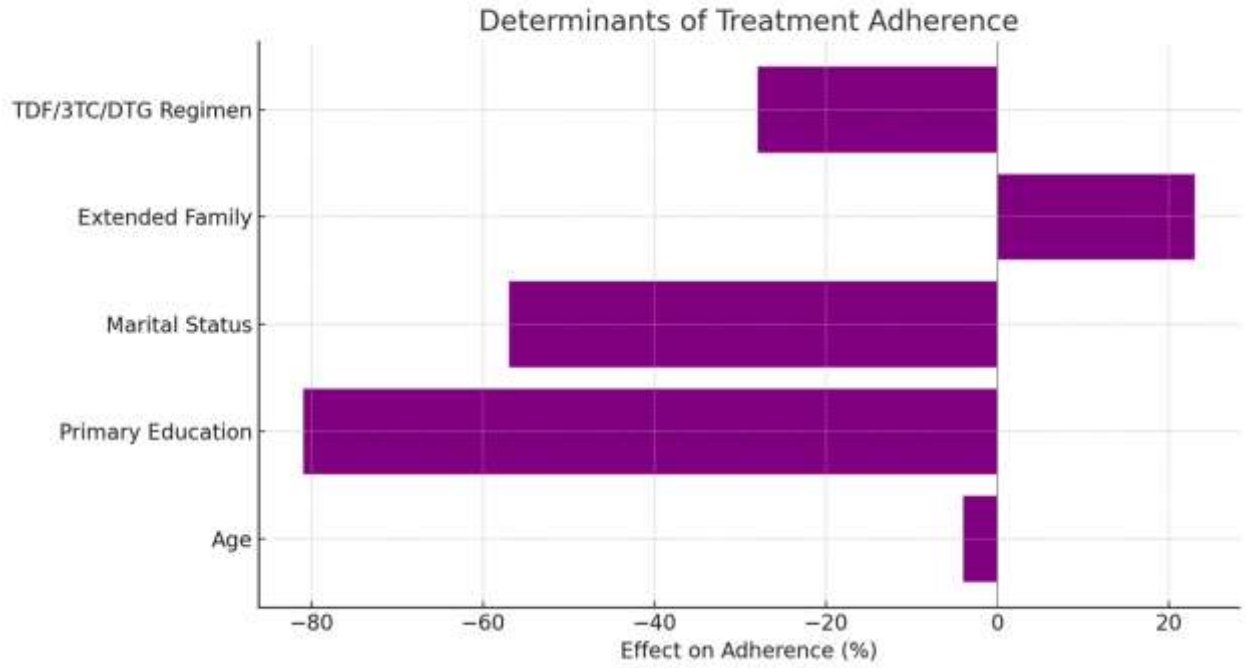
www.iprjb.org

regimen was another significant determinant. Adolescents on the **TDF/3TC/DTG** regimen were notably less likely to adhere (p=0.016), suggesting that this regimen might be associated with more side effects, complexity in administration, or even stigma related to its visible side effects. These findings highlight the multifaceted nature of adherence, influenced by personal, familial, and medical factors, and emphasize the need for tailored interventions that consider these variables.



Influence of Social Support on Adherence

Social support was a critical factor in treatment adherence. The majority of adolescents (82.8%) had someone accompanying them to hospital appointments, and 97.6% reported receiving support from clinic staff. Family support was paramount, with 63.3% of participants expressing high satisfaction with family support, followed by support from hospital staff (59.5%). Conversely, support from friends and the community was less satisfactory, with 26.8% reporting dissatisfaction. Adolescents living alone faced significant challenges, with a strong negative correlation between living alone and adherence (p=0.048). This underscores the importance of a robust support system in ensuring consistent treatment adherence.

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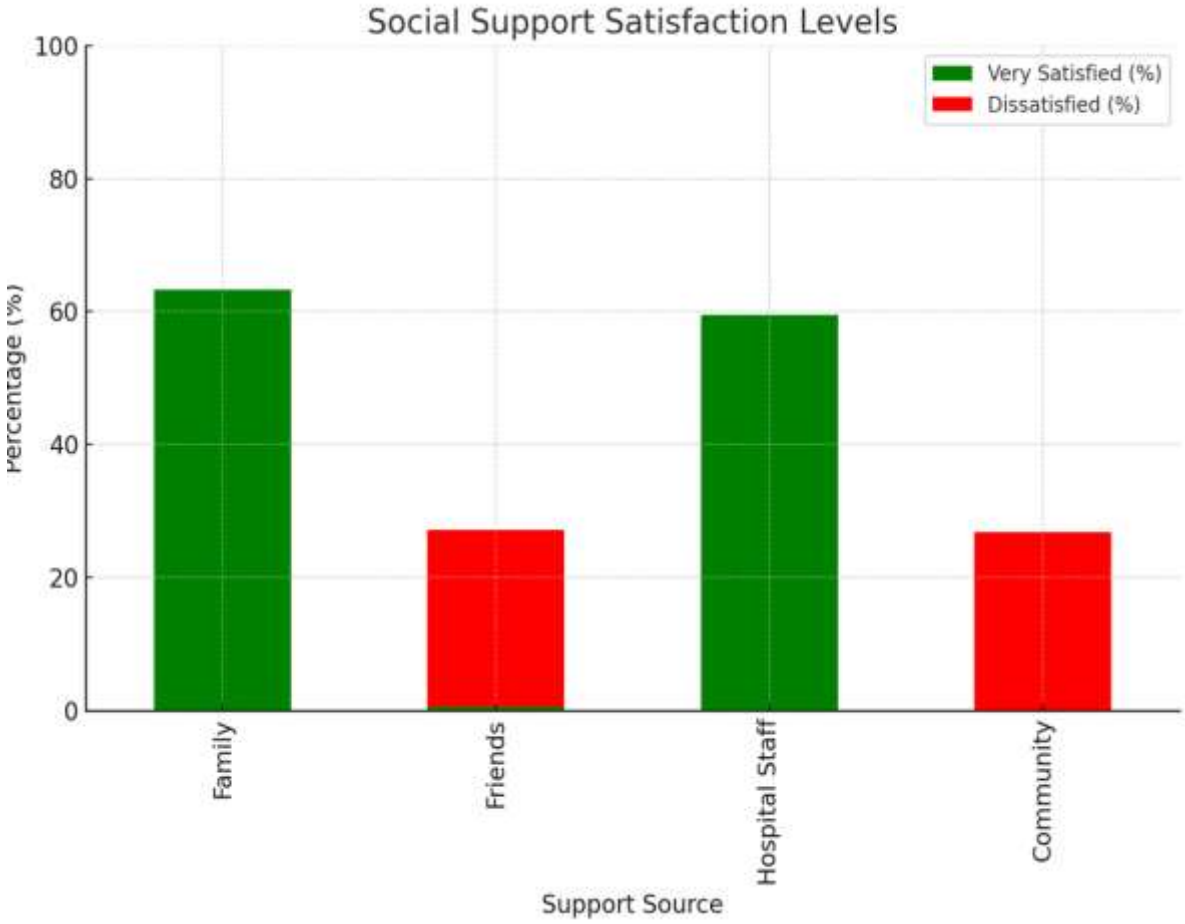
www.iprjb.org



Healthcare Setting and Its Impact on Adherence

Healthcare settings significantly influenced adherence levels. The frequency of clinic visits showed a negative correlation with adherence (p=0.026), suggesting that more frequent visits might be burdensome for some adolescents. Conversely, the time taken to receive services at the clinic positively correlated with adherence (p=0.002), possibly indicating that longer consultations provide more comprehensive care and support. Treatment by staff was crucial; negative interactions with healthcare providers significantly decreased adherence (p=0.000). The consistent availability of ARVs was highlighted as a strength, but challenges remained in accessing medications for comorbid conditions due to financial constraints.

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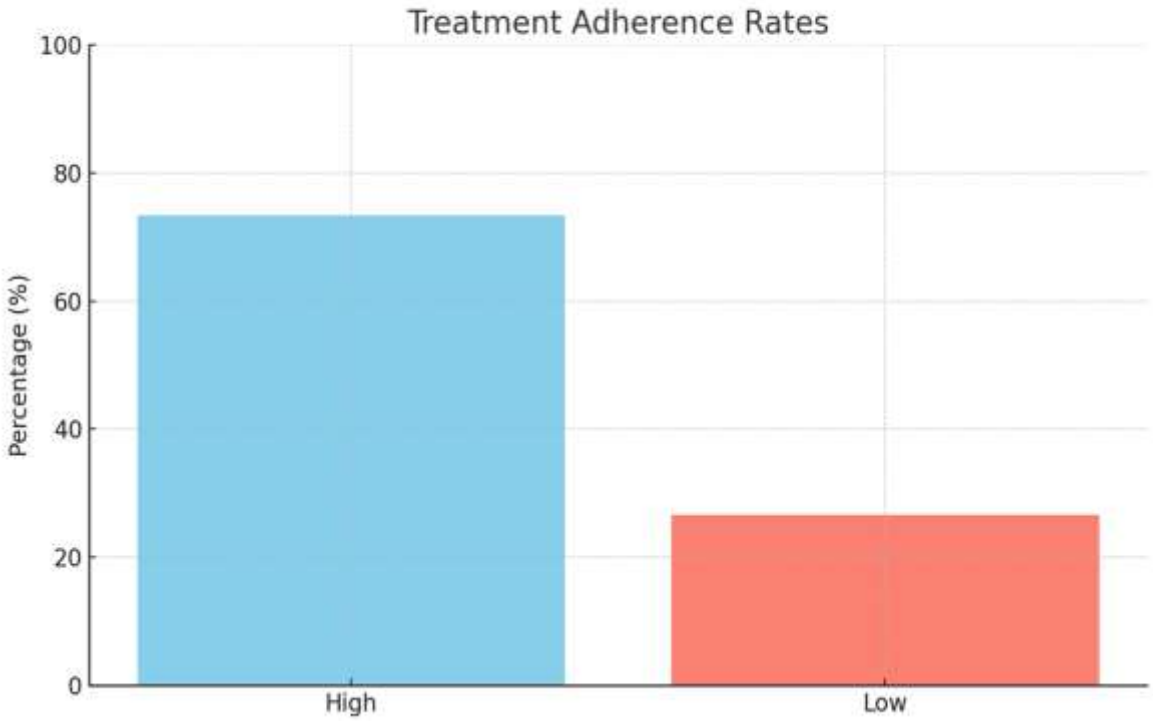

Qualitative Insights: Challenges and Recommendations

Focus group discussions revealed multifaceted challenges in ART adherence. Financial barriers were prominent, affecting both clinic attendance and the ability to purchase non-ARV medications. Environmental factors, such as poor weather conditions and transportation issues, also hindered access to care. Stigma and fear of being recognized at clinics further complicated adherence, particularly among school-going adolescents. Recommendations included enhancing financial support for transportation, reducing stigma through community programs, providing comprehensive education for caregivers and adolescents, and increasing healthcare worker engagement through home visits and personalized care.

Role of Caregivers and Healthcare Providers in Supporting Adherence

Caregivers played a pivotal role in supporting ART adherence through reminders, supervision, emotional support, and providing resources like food and transportation. Healthcare providers also contributed significantly through counseling, personalized attention, and maintaining confidentiality. Adequate staffing and the availability of modern medical equipment at clinics were crucial in ensuring comprehensive care. Adolescents appreciated supportive healthcare environments and special programs tailored to their needs, such as peer support groups and flexible clinic hours. Addressing financial barriers, enhancing social support networks, and improving healthcare infrastructure are essential for sustaining high adherence rates and improving health outcomes for HIV-infected adolescents.

Journal of Health, Medicine and Nursing
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Vol.11, Issue 1. No.5, pp 69 – 83, 2025
www.iprjb.org

Red-Yellow-Green Analysis of Demographic Characteristics and Treatment Adherence

The table provides a comprehensive overview of the factors influencing ART adherence among adolescents living with HIV/AIDS, categorized into areas of concern (Red), moderate performance (Yellow), and strengths (Green). Critical challenges include low higher education enrollment (only 2.4% reached college), financial dependence with only 3% having independent income, and lower adherence among those on the TDF/3TC/DTG regimen. Stigma remains a significant issue, with just 5.3% disclosing their HIV status to friends and 31.4% feeling treated differently. Moderate performance areas suggest opportunities for improvement, such as optimizing clinic visit frequency and enhancing peer and community support, where dissatisfaction rates exceed 26%. Living arrangements with one parent or siblings also indicate potential gaps in support. On the positive side, high ART adherence (73.4%) is complemented by strong family involvement, with 97% receiving financial support from parents/guardians and 63.3% expressing high satisfaction with family support. Additionally, healthcare access and staff engagement are commendable, with 97.6% receiving medication support from clinic staff and consistent ARV availability ensuring reliable treatment. This analysis highlights the need for targeted interventions in education, financial independence, and stigma reduction while reinforcing the existing strengths in family and healthcare support systems.

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Category	Red (Areas of Concern/Challenges)	Yellow (Moderate Performance/Opportunities for Improvement)	Green (Strengths/Positive Outcomes)
Education	- Only **2.4%** attained college/university education, indicating barriers to higher education.	- **46.6%** reached secondary education, but further education opportunities could be improved.	- Nearly **98.8%** had some level of formal education, suggesting basic educational access is widespread.
Income & Financial Support	- Only **3%** had independent income, indicating high financial dependence.	- Financial constraints affect access to non-ARV medications and transportation.	- **97%** depend on parents/guardians, who provide financial support for healthcare needs.
Medication Adherence	- Adolescents on **TDF/3TC/DTG** regimen showed lower adherence (p=0.016).	- Longer clinic visit intervals (3+ months) were linked to lower adherence rates.	- **73.4%** showed high adherence, with only **2.4%** missing recent doses.
Social Support	- **26.6%** dissatisfied with friend support; **26.8%** dissatisfied with community support.	- Adolescents living with one parent (**22.5%**) or siblings only (**4.8%**) need more targeted support.	- **63.3%** very satisfied with family support; **97.6%** received support from clinic staff for medication adherence.
Living Arrangements	- Only **0.6%** lived alone, facing significant adherence challenges.	- **40.2%** lived with extended family, positively influencing adherence, but other living situations need closer monitoring.	- Living with extended family significantly improved adherence (p=0.002).
Stigma & Disclosure	- Only **5.3%** disclosed HIV status to friends; **31.4%** felt treated differently due to HIV status.	- Fear of stigma affects clinic attendance and social interactions.	- **96.4%** did not experience different treatment from family, indicating strong family acceptance.
Healthcare Access	- Limited access to medications for comorbid conditions due to financial constraints.	- **70%** visited clinics every 3 months; optimizing visit frequency could improve adherence.	- **82.8%** had someone accompanying them to appointments, and ARV availability was consistently reliable.
Healthcare Staff Engagement	- Poor staff treatment reduced adherence by **31%** (p=0.000) when present.	- Some participants reported delays due to staff shortages or system issues.	- **97.6%** received medication support from clinic staff; **98.8%** continued medication even when feeling worse.
ART Regimen Challenges	- TDF/3TC/DTG regimen linked to lower adherence, despite being the most common regimen (**71.6%**).	- Differences in adherence between various ART regimens suggest the need for personalized treatment plans.	- Majority of respondents adhere well to other regimens, highlighting regimen-specific challenges rather than systemic.

Discussion

Interpretation of Findings: Adherence challenges among adolescents are consistent with global trends, highlighting stigma, social support, and healthcare interactions as critical factors. The positive impact of family involvement and frequent clinic visits emphasizes the need for targeted interventions. Stigma continues to be a significant obstacle, as it discourages adolescents from seeking timely care and adhering to prescribed treatment regimens. This finding aligns with existing global research that underscores stigma as a pervasive barrier to effective HIV care.

Family involvement emerged as a critical factor in promoting adherence, with younger adolescents benefiting significantly from parental or guardian support. However, the study noted a decline in family support as adolescents aged, a phenomenon mirrored in similar studies across sub-Saharan Africa. As adolescents strive for independence, family involvement must adapt to maintain a supportive environment without undermining autonomy.

The study also highlighted the role of healthcare interactions in adherence outcomes. Positive relationships with healthcare providers, characterized by empathy, respect, and consistent communication, were linked to better adherence rates. Conversely, negative experiences, such as long wait times and perceived judgment from staff, contributed to disengagement from care. Interventions that enhance provider training in adolescent-centered care are essential.

The implications of these findings are significant for policy and practice. Developing adolescent-focused programs that address stigma, reinforce family involvement, and improve access to mental health services is crucial. Integrating these programs into existing HIV care frameworks can foster resilience and adherence, ultimately improving health outcomes for adolescents living with HIV in Machakos County.

CONCLUSIONS AND RECOMMENDATIONS

Adherence rates among HIV-infected adolescents in Machakos County remain suboptimal, with younger adolescents demonstrating better adherence due to consistent family involvement. Family support plays a critical role in ensuring medication adherence, particularly when guardians actively participate in treatment routines and clinic visits. However, as adolescents grow older, family involvement tends to wane, contributing to a decline in adherence rates.

Clinical factors also influence adherence significantly. Simplified treatment regimens and regular clinical follow-ups have shown positive impacts on adherence levels. Adolescents on single-tablet regimens exhibit better consistency compared to those on complex regimens. Conversely, adverse drug reactions, such as nausea and fatigue, hinder adherence by causing discomfort and discouraging consistent medication use.

Stigma remains a major challenge in the adherence landscape. Social stigma, self-stigma, and healthcare-related stigma all negatively impact adolescent willingness to seek care and disclose their status. Community-driven interventions that promote awareness and reduce misconceptions about HIV are necessary to address this barrier effectively.

The importance of social support cannot be overstated. Both family members and healthcare staff contribute significantly to adherence outcomes by providing emotional, logistical, and informational support. Adolescents with strong support systems are more likely to maintain adherence, while those lacking such support exhibit higher rates of treatment discontinuation.

Recommendations

To enhance family support, educational programs should be developed to equip families with the skills and knowledge required to support adolescents with HIV. These programs can offer guidance on medication management, communication strategies, and coping mechanisms for stigma-related challenges.

Strengthening healthcare systems is essential for improving adolescent adherence. Establishing adolescent-friendly clinics with trained personnel, flexible appointment scheduling, and supportive environments can address the unique needs of this population. Additionally, launching community-based stigma reduction campaigns can foster greater acceptance and understanding of HIV, reducing the negative impacts of stigma on adherence. Simplifying ART regimens through the use of fixed-dose combinations can also enhance adherence by reducing pill burden and minimizing confusion. Finally, developing peer-led adherence workshops can provide adolescents with relatable role models who share their experiences and offer practical strategies for overcoming adherence challenges.

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