HHS Public Access

Author manuscript

AIDS Behav. Author manuscript; available in PMC 2025 July 30.

Published in final edited form as:

AIDS Behav. 2025 July ; 29(7): 2249–2257. doi:10.1007/s10461-025-04689-9.

Challenges Faced by Perinatally-Infected Kenyan Adolescents and Youth Living with HIV During the COVID-19 Pandemic

Manjot Singh[1], **Winstone Nyandiko**[2,3], **Allison Delong**[4], **Celestine Ashimosi**[3], **Dennis Munyoro**[3], **Janet Lidweye**[3], **Jack Nyagaya**[3], **Whitney Biegon**[3], **Josephine Aluoch**[3], **Ashley Chory**[5,6], **Edwin Sang**[3], **Eslyne Jepkemboi**[3], **Millicent Orido**[3], **Vladimir Novitsky**[1], **Joseph W Hogan**[4], **Rachel Vreeman**[5,6], **Rami Kantor**[1]

[1]Warren Alpert Medical School, Brown University, Providence, RI, USA

[2]Moi University College of Health Sciences, Eldoret, Kenya

[3]Academic Model Providing Access to Healthcare (AMPATH), Eldoret, Kenya

[4]Center for Statistical Sciences, Brown University, Providence, RI, USA

[5]Icahn School of Medicine at Mount Sinai, New York City, NY, USA

[6]Arnhold Institute for Global Health, New York City, NY, USA

Abstract

Wellness challenges experienced by adolescents and youth living with HIV (AYLWH) during COVID-19 are unknown and could guide HIV care in resource-limited settings. Between February/2021 and July/2022, perinatally-infected AYLWH at the Academic Model Providing Access to Healthcare (AMPATH) in western Kenya completed surveys assessing psychological, physical, socioeconomic, and antiretroviral nonadherence challenges and underwent viral load (VL) testing evaluating for virologic (VL>40 copies/mL) or treatment (VL>1,000 copies/mL) failure. Patterns in challenges, nonadherence, and VL measures by enrolment were evaluated using general additive models. Associations between challenges and nonadherence scores were quantified using linear regression; associations between non-adherence and failure were quantified using logistic regression. Both were adjusted for age, gender, and clinic. Among 442 participants enrolled in this cross-sectional study (median age 17 years, 49% female), 89% reported challenges (48% psychological, 66% physical, 62% socioeconomic) and 74% reported nonadherence. Significant between-individual variations by enrolment date were noted in physical challenges (e.g., illnesses and hospitalizations). Reporting more psychological, physical, or socioeconomic challenges were each associated with higher nonadherence. Higher nonadherence was associated with virologic and treatment failure (OR=1.22 per 1-unit higher nonadherence, 95% CI=1.01–

Corresponding author: Rami Kantor, MD, FIDSA, Division of Infectious Diseases, The Miriam Hospital, RISE 154, 164 Summit Avenue, Providence, RI 02906, rkantor@brown.edu.

Declarations

Competing Interests: All authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

Ethics Approval: The study was approved by the Moi University/Moi Teaching and Referral Hospital Institutional Research and Ethics Committee, and the National Commission for Science, Technology, and Innovation (NACOSTI) in Kenya, and the Mount Sinai (NY) and Lifespan (RI) Institutional Review Boards in the United States.

1.47, p<0.036; and OR=1.29, 95% CI=1.01–1.64, p<0.035, respectively). Kenyan AYLWH faced psychological, physical, and socioeconomic challenges during the COVID-19 pandemic. Although longitudinal studies are needed to determine whether these challenges exceed pre-pandemic levels or contribute to the observed increased antiretroviral nonadherence and treatment failure, our findings provide support the important relationships among these measures and may help clinicians and caregivers identify opportunities for interventions to support this vulnerable population.

Keywords

COVID-19; HIV; Antiretroviral adherence; Adolescents; Low-Resource Setting

INTRODUCTION

Severe acute respiratory syndrome-associated coronavirus 2 (SARS-CoV-2), responsible for coronavirus disease 2019 (COVID-19), infected over 766 million people and killed almost 7 million to date.[1] The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) no longer require social distancing and quarantining measures, which previously resulted in country-wide lockdowns, healthcare disruptions, income loss, food insecurity, homelessness, healthcare system overload, and mistrust in the government and medical system in their ability to mitigate the devastation caused by the pandemic.[2,3] However, there is much to learn from the pandemic experience to better prepare for current or future pandemics.

COVID-19 disproportionately affected people with HIV, who rely on healthcare systems for consistent access to care and antiretroviral therapy (ART) supply.[4] Community-based interventions to improve clinical outcomes within this population faced significant setbacks due to imposed restrictions.[5] Moreover, associated HIV clinic closures, telemedicine shifts, and ART supply shortages resulted in loss of contact with many people with HIV, particularly in resource limited settings (RLS).[4,6] This risk may be more apparent among adolescents and youth living with HIV (AYLWH), who are already developmentally more likely to disengage from care and face higher rates of HIV-related morbidity and mortality than other age groups due to social isolation from lack of peer support, engagement in risky behaviors like substance abuse and sexual initiation, and dependence on caregiver resources for clinic attendance.[7]

Kenya, a low-income country with high HIV prevalence (4.7%), saw its first SARS-CoV-2 case on March 13, 2020. Since then, Health Alerts published by the US Overseas Advisory Council (OSAC) and Situation Reports published by the Kenyan Ministry of Health (MoH) have demonstrated changes in masking and social distancing measures, travel bans, transportation services, access to specialized HIV care, and availability of COVID-19 treatment and vaccines (Figure, Online Resource 3).[8–12] Specifically, in February 2020, the National Emergency Response Committee was formed to coordinate pandemic preparation. In March, the government banned travel, public gatherings, and school activities, instated an indefinite 7pm-5am curfew, and increased SARS-CoV-2 testing. In April, masks became

mandatory, hospitals were designated to handle infections, and tax relief was implemented for vulnerable populations. In May, healthcare workers received special training. In June, the curfew was shortened to reduce economic burden. In July and August, local and international travel restrictions were lifted. In November, the curfew was further relaxed but large public gatherings like political rallies were still banned, as elections drew nearer.

In January 2021, schools reopened and a digital-verification system for negative SARS-CoV-2 PCR tests was established. In February, participants began enrollment in the present study. In March, case surges were noted in Nairobi and neighboring counties, and curfews and travel bans were reinstated, lifted in April, then reinstated again in June, with additional surges. In September and October, partnerships with prisons and transport services were formed to promote vaccinations among inmates and operators and new healthcare facilities were commissioned to increase care. In November, the government partnered with local manufacturers to increase ART supply. Finally, throughout 2021 and into 2022, Kenyans continued to see declines in restrictions as case burden dwindled and vaccines became available.

Concurrently, Kenyan clinics noted reduced HIV testing by ~22% and ART initiations by ~26%, increased missed visits by ~56%, and general ART supply shortages.[13,14] Such changes in care access could hinder antiretroviral adherence, which is crucial for preventing drug resistance and clinical progression.[15] The impact of such circumstances on AYLWH wellbeing is still unknown. Recent reports, including one from Kenya, noted increased income loss, food insecurity, depression and anxiety among AYLWH during the pandemic; however, the large breadth of challenges experienced by this population, along with their impact on adherence and virologic outcomes, remains to be elucidated.[16,17] Although many pandemic-related restrictions are now lifted and Kenyan HIV clinics have returned to normal capacity, carefully understanding the challenges experienced by AYLWH during the pandemic and their association with HIV care is critical, similarly to prior, and perhaps future, crises.[18,19]

As such, the present study describes psychological, physical, and socioeconomic challenges reported by a well-characterized cohort of Kenyan AYLWH during the COVID-19 pandemic, and elucidates associations of such reports with antiretroviral nonadherence and treatment failure. Our findings may increase awareness to such associations and highlight opportunities to improve HIV clinical outcomes among AYLWH in Kenya and other RLS.

METHODS

Study Design and Setting

This cross-sectional study was carried out at four HIV clinics under the Academic Model Providing Access to Healthcare (AMPATH) in and around Eldoret, Kenya, between February 2021 and July 2022. AMPATH is a partnership between academic health centers that use a centralized electronic medical record system to provide comprehensive HIV care to >160,000 patients, including >7,000 AYLWH, through >800 Ministry of Health clinics.[20,21] Clinics included the Moi Teaching and Referral Hospital (MTRH) in Eldoret

and three sub-county urban clinics in Webuye, Turbo, and Kitale (see Figure, Online Resource 1, which demonstrates a map of the AMPATH clinics in Kenya).

Participant Recruitment

AYLWH were enrolled in 2018 as part of an ongoing parent study (R01 AI14733301) assessing HIV drug resistance in a well characterized, longitudinally-followed cohort that was originally enrolled in 2010 according to the following eligibility criteria: (i) perinatally HIV-infected, (ii) ≤14 years old, (iii) on or beginning a 1st-line NNRTI-based ART, and (iv) receiving HIV care at one of the four clinics. Eligibility criteria for the current study included active enrollment in the parent study. Enrollment occurred as participants returned to clinic for their usual in-person visits during the pandemic. Informed consent was obtained from parents and/or caregivers and culturally appropriate assent from those over 10 years old.

Participant Wellness and Adherence Surveys

Enrolled participants and their parent/caregiver verbally completed surveys conducted by trained research assistants, utilizing validated measures or measures used elsewhere in this setting when available, to assess challenges experienced during COVID-19.[16] Specifically, surveys examined (i) psychological challenges, like depressed and anxious mood, using the Patient Health Questionnaire-2 (PHQ-2) and Generalized Anxiety Disorder-2 (GAD-2), respectively;[22,23] (ii) physical challenges, like recent/current COVID-19-related illnesses and hospitalizations; (iii) socioeconomic challenges, like education, income, food availability, and housing status changes, using the International epidemiology Databases to Evaluate AIDS (IeDEA) Adolescent Cohort Evaluation Sociodemographic Tracking Form;[24] and (iv) antiretroviral nonadherence using the IeDEA Comprehensive Adherence Measure for Pediatrics (see Table, Online Resource 2, which lists the questions asked in the survey).[25] Surveys also included specific prompts for referrals to AMPATH services for responses indicating a need for mental or physical health, or nutrition services.

HIV-1 Viral Load Assessment

Blood samples were collected for HIV-1 VL testing as part of the parent study. VL testing was performed at the AMPATH reference laboratory using the M2000 Realtime System (Abbott Park, Illinois, Chicago USA). Treatment failure (VL>1000 copies/mL; per WHO criteria), virologic suppression (VL<40 copies/mL), and virologic failure (VL>40 copies/mL) categories were assessed.[26] VL tests closest in time during or after the visit (but allowing within 7 days prior) to the surveys were extracted from the medical records.

Statistical Analyses

Survey and clinical data were summarized overall by two qualified statisticians. Challenge-specific composite scores were calculated by summing the PHQ-2 and GAD-2 scores for psychological challenges (scale 0–12), and the relevant positive responses for physical challenges (scale 0–5) and socioeconomic (scale 0–6) challenges. A nonadherence composite score was similarly calculated (scale 0–6). Higher scores among all composite

measures indicated worse challenges and/or nonadherence (see Table, Online Resource 2, which lists the questions asked in the survey).

Generalized additive models (GAM) with non-linear regression splines were used to describe observed enrollment patterns in the challenges, nonadherence, and VL measures based on the date of study enrollment, adjusting for clinic, gender, and age. Challenges and nonadherence scores were modeled as a continuous outcome and VL (>1,000 copies/mL, and >40 copies/ml) were modeled as a binomial outcome.

Linear regression, adjusting for age, clinic, and gender, was used to model ART nonadherence as a function of the three wellness measures. Logistic regression, adjusting for age, gender, clinic, and time between nonadherence measurement and VL, was used to separately model virologic (VL>40) and treatment failure (VL>1000) endpoints as functions of nonadherence. All models included age, gender, clinic and, for VL, the time between the nonadherence measurement and VL. Linear trend assumptions were first assessed using spline terms to model continuous predictors. The VL models were rerun with the addition of the three wellness challenges to assess whether the association between nonadherence and VL is attenuated when we account for the challenges measures. All analyses were performed using R version 4.0.2.[27]

RESULTS

Participant Enrollment and Characteristics

Of the 443 AYLWH enrolled in the parent study, 442 were enrolled in the present study (one defaulted) (see Figure, Online Resource 4, which demonstrates a flowchart of the study population). All participants answered the wellness questionnaires, one refused the adherence questionnaire, and two had no eligible VL data, and were thus omitted from adherence and VL analyses, respectively.

Participant demographics are summarized in Table 1. Of the 442 enrolled, 88% were enrolled during the first half of 2021 and 59% were receiving HIV care at MTRH. Most participants were between 15–19 years old (52%), 49% were female, 80% resided in their usual residence, 85% were students, 16% working, and 7% had others relying on their income. The mean time on ART was 11.9 years, with tenofovir-disoproxil-fumarate + lamivudine + dolutegravir being the most common regimen (69%), and the mean CD4 levels were 839 cells/μl.

Wellness Challenges

At least one challenge was reported by 89% of the 442 participants who completed these surveys, including 48% psychological, 66% physical, and 62% socioeconomic challenges. Highest characteristics included ≥1 point on PHQ-2 (36%; assessing depressed mood) and ≥1 point on GAD-2 (29%; assessing anxious mood), recent COVID-19 symptoms (60%), and food (31%), income (35%), and housing (20%) insecurity (see Table, Online Resource 5, which demonstrates the individual challenges experienced by AYLWH). The median challenge-specific composite scores were 0 (IQR 0 to 8) for psychological, 1 (IQR 0 to 4) for physical, and 1 (IQR 0 to 4) for socioeconomic challenges. Examination of challenge-

specific composite scores by enrollment month provided little evidence of differences in participant characteristics based on enrollment time. However, we found some evidence that physical challenges scores of participants enrolled between March and May 2021 were lower than for participants enrolled in the other months; other scores had wide variability and provided less evidence for patterns (Figure 1).

Antiretroviral Nonadherence

Antiretroviral nonadherence was reported by 74% of the 441 participants who completed this survey, with most (50%) indicating problems taking medications around others (see Table, Online Resource 5, which demonstrates the individual adherence concerns among AYLWH). The median nonadherence composite score was 1 out of 6 possible challenges (IQR 0 to 2) among all participants. The value of the adherence score did not appear to differ by study enrollment date, although standard errors are large (Figure 1).

VL Levels

Virologic failure (median VL 1,497 copies/mL, IQR 112 to 11,262 copies/mL) and treatment failure (median VL 10,664 copies/mL, IQR 3,964 to 27,152 copies/mL) were observed among 19% and 10% of the 439 participants with adherence and VL data available, respectively. Patterns of observed virologic and treatment failure by participant enrollment date are shown in Figure 1. Online Resource 5 provides summaries of the cohort, overall and stratified by virologic and treatment failure.

Wellness Challenges and Nonadherence

ART nonadherence was significantly associated with challenge-specific composite scores, with nonadherence higher by 0.21 (95% CI=0.12–0.29, p<0.001), 0.29 (95% CI=0.15–0.43, p<0.001), and 0.17 (95% CI=0.06–0.29, p=0.003) for every point difference in psychological, physical, and socioeconomic challenge score, respectively (Table 2).

Nonadherence and VL

Antiretroviral nonadherence was significantly associated with virologic (OR=1.22 per 1-higher point in nonadherence composite score, 95% CI=1.01–1.47, p=0.036) and treatment (OR=1.29 per 1-higher point, 95% CI=1.01–1.64, p=0.035) failure (Table 3). Inclusion of wellness challenges composite scores in these models resulted in a modest attenuation of this association and subsequently greater p-values for both virologic (OR=1.18 per 1-higher point, CI=0.96–1.14, p=0.111) and treatment (OR=1.24 per 1-higher point, CI=0.95–1.61, p=0.104) failure (see Table, Online Resource 6, which demonstrates the association between nonadherence and virologic and treatment failure with wellness challenges included in the model).

DISCUSSION

The vast majority (89%) of 442 AYLWH from one large hospital and three smaller sub-county urban clinics in Kenya reported psychological, physical and/or socioeconomic challenges during the second year of the COVID-19 pandemic; many also reported antiretroviral nonadherence, and some experienced virologic or treatment failure. These

wellness challenges were independently associated with nonadherence and nonadherence was independently associated with virologic or treatment failure. Despite the cross-sectional study design and the inability to determine whether these challenges exceed pre-pandemic levels, the observed associations between them and higher antiretroviral nonadherence are highlighted for providers and offer opportunities for patient-centered interventions once such challenges are reported by this vulnerable population to improve their care.

Before the study period, Kenya placed several public health restrictions to limit SARS-CoV-2 spread, following global trends.[11,12,28] Although many had since been lifted and vaccines had become publicly available by the beginning of this study, many AYLWH continued to experience psychological, physical, and/or socioeconomic challenges. Similar observations have been reported, but with minimal focus on vulnerable youth living with HIV.[29–32] Our findings reinforce the few reports that do focus on this particular population, including the one from Kenya, and extend them to characterize the large breadth of challenges experienced and importantly, their association with nonadherence and treatment failure in this vulnerable population.[16,17] These experienced challenges and their frequencies (e.g. anxiety/depression symptoms for days; occasional COVID-19-related physical symptoms; and at least some socioeconomic challenges), especially during a public health crisis, should not be overlooked as they were associated with nonadherence. These findings highlight the need for early and continued interventions to support this population. Though not tested here, interventions such as home-based care and peer support groups through online social media platforms, should be explored to evaluate their impact on minimizing such effects, even with positive changes in the public health local and global landscape.

Although the study was not designed to detect temporal trends, participants were enrolled over a period of 17 months during the pandemic, and challenges were reported throughout with relative overall consistency, despite the changing public health landscape. In March and June of 2021, for instance, Kenya experienced two surges and associated restrictions. However, Kenyan AYLWH enrolled in the first half of 2021 did not report higher psychological and socioeconomic challenges, possibly due to increased engagement in HIV-related care, geographical distance from study sites, small sample size, or differences in participant characteristics. They did note fewer physical challenges during these surges, possibly attributed to reduced incidence of influenza, common cold, and other infections associated with masking and social distancing.[33] In the latter half of 2021 and throughout 2022, vaccine supplies became prevalent; however, reported challenges persisted, despite these ‘good’ public health campaigns. These lessons provide key insights into the wellness of AYLWH in RLS during current and future crises.

The high rate and overall consistency in reporting of challenges among AYLWH throughout the study period raise concerns about their potential association with worse nonadherence and virologic suppression. Recent studies among African people with HIV have shown that lower utilization of HIV services, reductions in routine testing, and limitations in ART availability during the pandemic can contribute to incomplete antiretroviral adherence.[34–36] However, adherence among AYLWH in the United States has also been attributed to age, education, housing and job security, depression and anxiety, independently from

COVID-19.[37] The association between these factors and adherence during the pandemic, especially among the vulnerable AYLWH in RLS, has received minimal emphasis.[38–40] Our study uniquely showed that many AYLWH also had difficulties adhering to ART. Though causal associations between psychological, physical, and socioeconomic challenges and nonadherence are impossible to make, the temporal occurrence, especially in conjunction with virologic and treatment failure, are concerning. These concerns are further heightened given the lower pre-pandemic nonadherence rate (53% vs 74% reported here) in this same population.[41] We speculate that these associations, which should be further studied, suggest that COVID-19 – especially restrictions imposed by it – may modify wellness and lead to reduced adherence and, subsequently, increased likelihood of treatment failure within this vulnerable population. Such speculations, if true, should guide caregivers and providers to be especially sensitive to self-reported challenges from this vulnerable population and consider formally assessing them and their potential indication of nonadherence.

We recognize several limitations in this study. First and foremost, we had no comparison group without COVID-19 pandemic exposure as reference to draw more robust conclusions and examine direct associations between wellness challenges and the pandemic. Second, the cohort only includes perinatally HIV-infected youth, which might limit generalizability. Nonetheless, most global perinatally infected youth live in settings similar to Kenya. Third, as Kenya experienced fewer COVID-19 reported cases than developed countries, its population may not have been as severely impacted by the pandemic and, as such, results may not translate to AYLWH in areas more severely affected. Fourth, while we do adjust for clinic-level variation, the effect of location may be of interest in explaining variability of challenges, nonadherence scores, and virologic outcomes. However, because there is only one large hospital in the city center, it was not possible to distinguish the main effect of that location from the main effect of the smaller clinics. Finally, while we utilized validated questionnaires where possible, only adherence and mental health questionnaires were previously validated which, along with response and recall biases, may confound data interpretation.

In conclusion, the majority of examined Kenyan AYLWH experienced psychological, physical, and socioeconomic challenges during the COVID-19 pandemic. These challenges were associated with antiretroviral nonadherence and, in turn, virologic and treatment failure. Though a direct association between the pandemic with its interrelated restrictions, and the experienced wellness challenges and evaluated viral outcomes could not have been made in the present study, our findings suggest that anticipating and addressing such challenges early on during current and future public health crises could significantly improve clinical outcomes within this vulnerable population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

Special thanks to Leslie Enane, MD, MPH, Indiana University School of Medicine for generating the COVID-19 focused survey used in this study. All authors have read and agreed to the published version of the manuscript.

Funding:

This work was supported in part by National Institutes of Health [R01 AI147333 to RK and RV, K24 AI134359 to RK, and P30 AI042853 to RK and JH]. Additional support was provided by Brown University Framework in Global Health Award, Emerging Infectious Diseases [R25 AI140490 to MS], and Primary Care Population Medicine (MS). Special thanks to the Fogarty International Center of the National Institutes of Health [Award Number D43TW010050 to MS] for supporting this project.

REFERENCES

1. Coronavirus (COVID-19) Dashboard. World Health Organization. Accessed April 2, 2022. https://covid19.who.int
2. Quarantine & Isolation. Centers for Disease Control and Prevention. March 30, 2022. Accessed July 26, 2022. https://www.cdc.gov/coronavirus/2019-ncov/your-health/quarantine-isolation.html
3. Second round of the national pulse survey on continuity of essential health services during the COVID-19 pandemic. World Health Organization. Accessed July 26, 2022. https://www.who.int/publications-detail-redirect/WHO-2019-nCoV-EHS-continuity-survey-2021.1
4. Brown LB, Spinelli MA, Gandhi M. The Interplay between HIV and COVID-19: summary of the data and responses to date. Curr Opin HIV AIDS. 2021;16(1):63–73. doi:10.1097/COH.0000000000000659 [PubMed: 33186229]
5. Uwishema O, Taylor C, Lawal L, et al. The syndemic burden of HIV/AIDS in Africa amidst the COVID-19 pandemic. Immun Inflamm Dis. 2021;10(1):26–32. doi:10.1002/iid3.544 [PubMed: 34606689]
6. Nkengasong J HIV and COVID-19: juxtaposition of two pandemics. Lancet HIV. 2022;9(5):e300–e301. doi:10.1016/S2352-3018(22)00095-9 [PubMed: 35489372]
7. Vreeman RC, Rakhmanina NY, Nyandiko WM, Puthanakit T, Kantor R. Are we there yet? 40 years of successes and challenges for children and adolescents living with HIV. J Int AIDS Soc. 2021;24(6):e25759. doi:10.1002/jia2.25759 [PubMed: 34097352]
8. Overseas Security Advisory Council. Accessed April 3, 2022. https://www.osac.gov/
9. Ministry of Health - Republic of Kenya. Accessed April 3, 2022. https://www.health.go.ke/
10. Kenya's National HIV Survey Shows Progress Towards Control of the Epidemic. Nairobi, 20th February 2020. Ministry of Health - Republic of Kenya. Accessed April 3, 2022. https://www.health.go.ke/kenyas-national-hiv-survey-shows-progress-towards-control-of-the-epidemic-nairobi-20th-february-2020/
11. Health Alert: Government of Kenya Announces Curfew Effective March 27. Overseas Security Advisory Council. Accessed April 3, 2022. https://www.osac.gov/Content/Report/fdaa6d90-4a90-4f8a-8eab-184b375bb291
12. Health Alert for U.S. citizens: Government of Kenya Announces Suspension of International Flights. Overseas Security Advisory Council. March 22, 2020. Accessed April 3, 2022. https://ke.usembassy.gov/health-alert-for-u-s-citizens-government-of-kenya-announces-suspension-of-international-flights/
13. Okegbe T, Williams J, Plourde KF, Oliver K, Ddamulira B, Caparrelli K. Impact of COVID-19 on HIV Adolescent Programming in 16 Countries With USAID-Supported PEPFAR Programs. J Acquir Immune Defic Syndr 1999. 2023;93(4):261–271. doi:10.1097/QAI.0000000000003201
14. Muhula S, Opanga Y, Oramisi V, et al. Impact of the First Wave of the COVID-19 Pandemic on HIV/AIDS Programming in Kenya: Evidence from Kibera Informal Settlement and COVID-19 Hotspot Counties. Int J Environ Res Public Health. 2021;18(11):6009. doi:10.3390/ijerph18116009 [PubMed: 34205036]
15. Clutter DS, Jordan MR, Bertagnolio S, Shafer RW. HIV-1 Drug Resistance and Resistance Testing. Infect Genet Evol J Mol Epidemiol Evol Genet Infect Dis. 2016;46:292–307. doi:10.1016/j.meegid.2016.08.031
16. Enane LA, Apondi E, Aluoch J, et al. Social, economic, and health effects of the COVID-19 pandemic on adolescents retained in or recently disengaged from HIV care in Kenya. PloS One. 2021;16(9):e0257210. doi:10.1371/journal.pone.0257210 [PubMed: 34506555]

17. Hong C, Queiroz A, Hoskin J. The impact of the COVID-19 pandemic on mental health, associated factors and coping strategies in people living with HIV: a scoping review. J Int AIDS Soc. 2023;26(3):e26060. doi:10.1002/jia2.26060 [PubMed: 36912238]
18. Mann M, Diero L, Kemboi E, et al. Antiretroviral Treatment Interruptions Induced by the Kenyan Postelection Crisis Are Associated With Virological Failure. J Acquir Immune Defic Syndr 1999. 2013;64(2):220–224. doi:10.1097/QAI.0b013e31829ec485
19. Mann M, Lurie MN, Kimaiyo S, Kantor R. Effects of political conflict-induced treatment interruptions on HIV drug resistance. AIDS Rev. 2013;15(1):15–24. [PubMed: 23449225]
20. AMPATH Kenya. Accessed April 3, 2022. https://www.ampathkenya.org
21. Mamlin BW, Biondich PG. AMPATH Medical Record System (AMRS): collaborating toward an EMR for developing countries. AMIA Annu Symp Proc AMIA Symp. Published online 2005:490–494. [PubMed: 16779088]
22. Gelaye B, Wilson I, Berhane HY, et al. Diagnostic validity of the Patient Health Questionnaire-2 (PHQ-2) among Ethiopian adults. Compr Psychiatry. 2016;70:216–221. doi:10.1016/j.comppsych.2016.07.011 [PubMed: 27567282]
23. Ndetei DM, Khasakhala L, Nyabola L, et al. The prevalence of anxiety and depression symptoms and syndromes in Kenyan children and adolescents. J Child Adolesc Ment Health. 2008;20(1):33–51. doi:10.2989/JCAMH.2008.20.1.6.491 [PubMed: 25861005]
24. Vreeman RC, Nyandiko WM, Sang E, Musick BS, Braitstein P, Wiehe SE. Impact of the Kenya post-election crisis on clinic attendance and medication adherence for HIV-infected children in western Kenya. Confl Health. 2009;3:5. doi:10.1186/1752-1505-3-5 [PubMed: 19344523]
25. Vreeman RC, Nyandiko WM, Liu H, et al. Measuring adherence to antiretroviral therapy in children and adolescents in western Kenya. J Int AIDS Soc. 2014;17(1):19227. doi:10.7448/IAS.17.1.19227 [PubMed: 25427633]
26. World Health Organization. Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection: Recommendations for a Public Health Approach. 2nd ed. World Health Organization; 2016. Accessed May 19, 2023. https://apps.who.int/iris/handle/10665/208825
27. R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/
28. First case of coronavirus disease confirmed in Kenya. Ministry of Health - Republic of Kenya. Accessed April 3, 2022. https://www.health.go.ke/first-case-of-coronavirus-disease-confirmed-in-kenya/
29. Egger D, Miguel E, Warren SS, et al. Falling living standards during the COVID-19 crisis: Quantitative evidence from nine developing countries. Sci Adv. 2021;7(6):eabe0997. doi:10.1126/sciadv.abe0997 [PubMed: 33547077]
30. Kakaei H, Nourmoradi H, Bakhtiyari S, Jalilian M, Mirzaei A. Effect of COVID-19 on food security, hunger, and food crisis. COVID-19 Sustain Dev Goals. Published online 2022:3–29. doi:10.1016/B978-0-323-91307-2.00005-5
31. Parisi CE, Varma DS, Wang Y, et al. Changes in Mental Health Among People with HIV During the COVID-19 Pandemic: Qualitative and Quantitative Perspectives. AIDS Behav. 2022;26(6):1980–1991. doi:10.1007/s10461-021-03547-8 [PubMed: 34993668]
32. Dyer J, Wilson K, Badia J, et al. The Psychosocial Effects of the COVID-19 Pandemic on Youth Living with HIV in Western Kenya. AIDS Behav. 2021;25(1):68–72. doi:10.1007/s10461-020-03005-x [PubMed: 32816193]
33. Olsen SJ. Decreased Influenza Activity During the COVID-19 Pandemic — United States, Australia, Chile, and South Africa, 2020. MMWR Morb Mortal Wkly Rep. 2020;69. doi:10.15585/mmwr.mm6937a6
34. Dorward J, Khubone T, Gate K, et al. The impact of the COVID-19 lockdown on HIV care in 65 South African primary care clinics: an interrupted time series analysis. Lancet HIV. 2021;8(3):e158–e165. doi:10.1016/S2352-3018(20)30359-3 [PubMed: 33549166]
35. Nyoni T, Okumu M. COVID-19-Compliant Strategies for Supporting Treatment Adherence Among People Living with HIV in Sub-Saharan Africa. AIDS Behav. 2020;24(9):2473–2476. doi:10.1007/s10461-020-02888-0 [PubMed: 32333204]

36. Benade M, Long L, Rosen S, Meyer-Rath G, Tucker JM, Miot J. Reduction in initiations of HIV treatment in South Africa during the COVID pandemic. BMC Health Serv Res. 2022;22(1):428. doi:10.1186/s12913-022-07714-y [PubMed: 35361209]

37. Williams PL, Storm D, Montepiedra G, et al. Predictors of adherence to antiretroviral medications in children and adolescents with HIV infection. Pediatrics. 2006;118(6):e1745–1757. doi:10.1542/peds.2006-0493 [PubMed: 17101712]

38. Wagner GJ, Wagner Z, Gizaw M, et al. Increased Depression during COVID-19 Lockdown Associated with Food Insecurity and Antiretroviral Non-Adherence among People Living with HIV in Uganda. AIDS Behav. 2022;26(7):2182–2190. doi:10.1007/s10461-021-03371-0 [PubMed: 34570315]

39. Suryana K, Suharsono H, Indrayani AW, Wisma Ariani LNA, Putra WWS, Yaniswari NMD. Factors associated with anti-retroviral therapy adherence among patients living with HIV during the COVID-19 pandemic: A cross-sectional study. Front Psychiatry. 2022;13:824062. doi:10.3389/fpsyt.2022.824062 [PubMed: 36186875]

40. van Staden Q, Laurenzi CA, Toska E. Two years after lockdown: reviewing the effects of COVID-19 on health services and support for adolescents living with HIV in South Africa. J Int AIDS Soc. 2022;25(4):e25904. doi:10.1002/jia2.25904 [PubMed: 35475319]

41. Vreeman R, Nyandiko W, DeLong A, et al. Adherence to antiretroviral therapy (ART), drug resistance, and their impact on evolving viral suppression among a long-term cohort of youth living with perinatal HIV infection in western Kenya. Presented at: July 23, 2023; Brisbane, Australia.

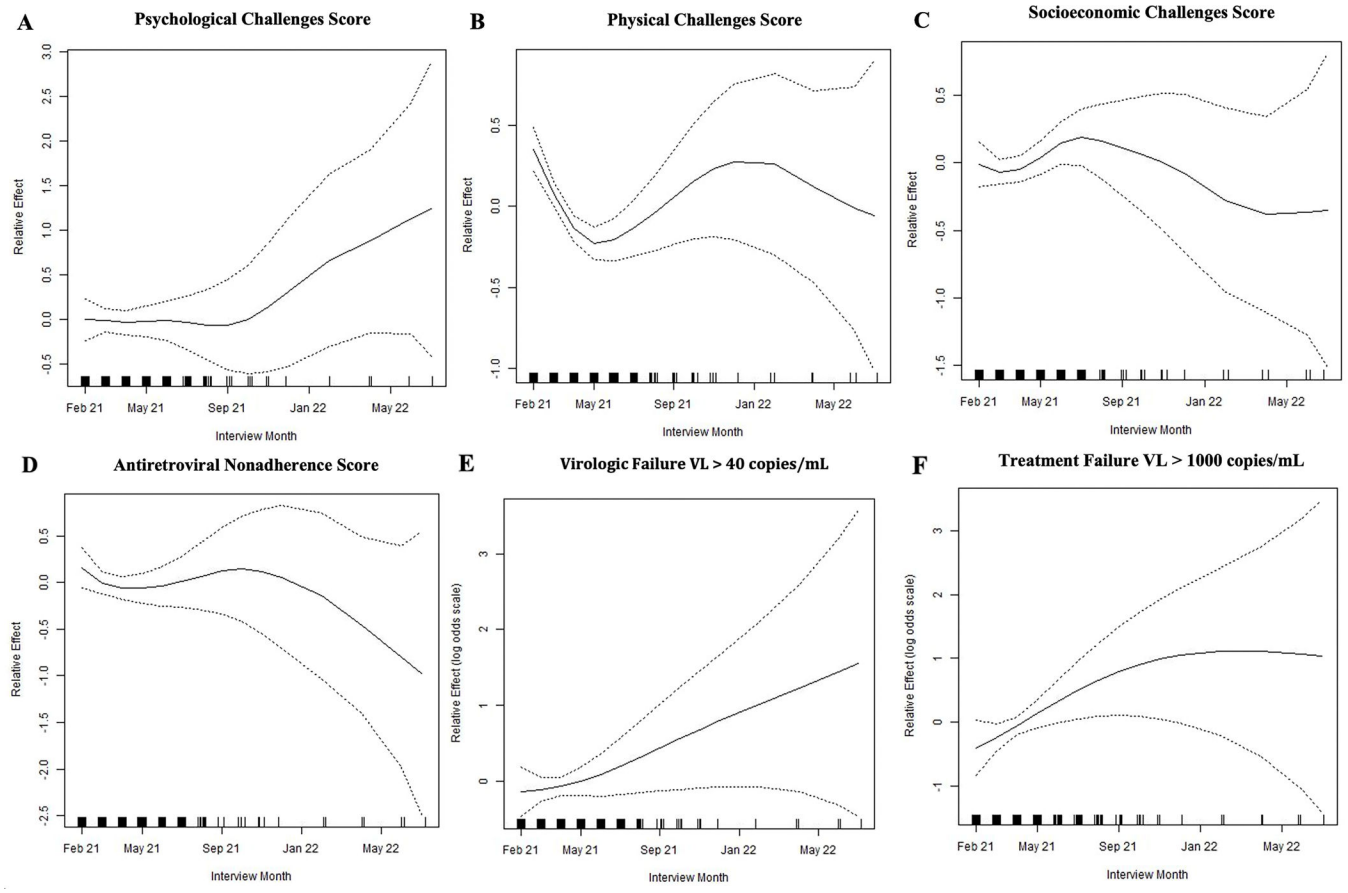

Figure 1.

Trajectories of challenges and nonadherence measures across enrollment months. This figure represents the relative effect of interview month (X-axis) on individual wellness challenges (Y-axes; psychological-panel A; physical-panel B, socioeconomic-panel C), antiretroviral nonadherence (panel D), viral failure (panel E) and treatment failure (panel F) over the study months (X-axes). Sample sizes of enrollments for each month are represented by the thickness of the black lines on the X-axes. Upper and lower standard errors are represented by the dashed lines.

Table 1.

Characteristics of enrolled AYLWH, overall and stratified by virologic and treatment failure

Characteristic[a]	Total (N = 442)[b]
Enrollment Quarter	
2021	
Jan-Mar	186 (42)
Apr-Jun	202 (46)
Jul-Sep	39 (9)
Oct-Dec	8 (2)
2022	
Jan-Mar	2 (0)
Apr-Jun	4 (1)
Jul-Sep	1 (0)
Clinic Site	
MTRH	260 (59)
Kitale	49 (11)
Turbo	69 (16)
Webuye	64 (14)
Age	
5–9	4 (1)
10–14	102 (23)
15–19	230 (52)
20–24	104 (24)
25+	2 (0)
Sex	
Female	218 (49)
Social Status	
Usual Residence	355 (80)
Enrolled in school	376 (85)
Earning income	72 (16)
Others rely on income	30/72 (42)
Years on ART	11.9 (2.1)
Current ART Regimen	
ABC/3TC/ATV/R	2 (0)
ABC/3TC/DTG	33 (7)
ABC/3TC/EFV	2 (0)
ABC/3TC/LPV/R	8 (2)
AZT/3TC/ATV/R	6 (1)
AZT/3TC/DTG	11 (2)
AZT/3TC/LPV/R	15 (3)
TDF/3TC/ATV/R	49 (11)
TDF/3TC/DTG	307 (69)

Characteristic[a]	Total (N = 442)[b]
TDF/3TC/DTG/DRV/R	1 (0)
TDF/3TC/EFV	6 (1)
TDF/3TC/LPV/R	1 (0)
AZT/3TC/DTG	1 (0)
CD4 Levels[c]	
Count	839 (435)
Percentage	30 (11)

[a]Categorical measures are presented as count (frequency) and continuous measures are presented as mean (standard deviation).

[b]Two participants with VL data before -7 days of the study visit were placed in the virologically suppressed group.

[c]N = 428, omitting 14 missing CD4 levels. CD4 levels for most participants were, on average, only available from three years before study enrollment.

Abbreviations: 3TC = lamivudine; ABC = abacavir; ATV = atazanavir; AYLWH = adolescents and youth living with HIV; AZT = zidovudine; DTG = dolutegravir; DRV = darunavir; EFV = efavirenz; LPV = lopinavir; MTRH = Moi Teaching and Referral Hospital; R = ritonavir; TDF = tenofovir disoproxil fumarate; VL = viral load.

Table 2.

Antiretroviral nonadherence as a function of challenges, age, sex and clinic site, assessed by the regression model[a]

Covariate	Coeff.	95% CI	p-value
Challenges (per 1 unit)			
Psychological challenges	0.21	0.12, 0.29	<0.001
Physical challenges	0.29	0.15, 0.43	<0.001
Socioeconomic challenges	0.17	0.06, 0.29	0.003
Age (per 1 year)	0.00	−0.04, 0.03	0.801
Sex (vs Female)			
Male	0.27	0.05, 0.50	0.015
Clinic Site (vs Kitale)			
MTRH	0.00	−0.36, 0.37	0.986
Turbo	−0.22	−0.65, 0.22	0.329
Webuye	−0.01	−0.45, 0.43	0.965

[a]N = 441, omitting the 1 without adherence score.

Abbreviations: CI = confidence interval; MTRH = Moi Teaching and Referral Hospital.

Table 3.

Association between antiretroviral nonadherence and virologic and treatment failure

	Virologic Failure VL ≥ 40 (N = 84)			Treatment Failure VL ≥ 1000 (N = 44)		
Covariate	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Antiretroviral Nonadherence (per 1 unit)	1.22	1.01, 1.47	0.036	1.29	1.01, 1.64	0.035
Age (per 1 year)	1.06	0.98, 1.14	0.162	1.06	0.96, 1.18	0.234
Sex (vs Female)						
Male	0.86	0.53, 1.41	0.559	0.91	0.48, 1.74	0.773
Clinic Site (vs Kitale)						
MTRH	2.70	1.02, 9.32	0.070	1.60	0.52, 6.97	0.463
Turbo	2.40	0.77, 9.14	0.156	1.74	0.45, 8.52	0.447
Webuye	3.91	1.31, 14.57	0.023	2.27	0.61, 10.91	0.250
VL Timing (per 1 day)[a]	1.00	0.99, 1.00	0.117	0.99	0.98, 1.00	0.115

[a]VL timing indicates the difference in number of days between the interview date and the blood sample collection date.

Abbreviations: CI = confidence interval; OR = odds ration; MTRH = Moi Teaching and Referral Hospital; VL = viral load.