

Prevalence, Correlates and Treatment Needs of Dental Caries Among People on Antiretroviral Therapy in Uganda: A Cross Sectional Study

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Abstract

Background:

Oral diseases are estimated to affect half of people living with HIV in the global north, and are often marked by pain, discomfort, disfigurement and reduced quality of life. Both HIV-specific and antiretroviral therapy-associated oral diseases have been found in this population. However, the association between antiretroviral therapy use and dental caries has not been well described in rural Africa where majority of people living with HIV reside, and where health behaviors and access to dental care vary significantly from the global north.

Methods:

A cross-sectional study was conducted among PWH attending a high volume HIV clinic with an enrollment of 10,000 patients in a regional referral hospital in Southwestern Uganda. The clinic is located in an urban setting with a large rural catchment area. Oral health data was collected using the modified World Health Organization oral health questionnaire for adults. Dental examinations were conducted to identify and classify dental caries using the decayed, missing, filled, teeth (DMFT) index and compute the treatment need. Logistic regression models were employed to identify correlate of dental caries.

Results:

A total of 194 participants were included in the study. The majority were females (124/194, 63.9%) with a median age of 42 years (IQR 36-49). The prevalence of dental caries experience among individuals on ART was 67%, (130/194), 95% CI (60-75%). The mean DMFT index score was 4 (IQR 2-6) and treatment need was 96%. A higher CD4 count was associated with the presence of dental caries (OR 0.403, 95% CI (0.175-0.932) although it was not significant at multivariate analysis.

Conclusion

There is a high prevalence of dental caries among PWH on ART in Uganda. Our data demonstrate a high oral treatment need among the participants. We recommend inclusion of preventive and therapeutic oral care into HIV care in this region.

Background

Globally, oral diseases affect nearly 3.5 billion people [1]. Untreated dental caries in permanent teeth is the most prevalent and common oral health condition [2]. Evidence has shown that oral diseases affect 40–50% of people living with HIV (PLWH) and often begin early in the disease's course [3]. Oral diseases often cause pain, discomfort, and disfigurement compromising the quality of life and productivity of individuals affected; thus delaying the target to achieve Sustainable Development Goals 1: No poverty and 3: Good health and well-being. HIV increases the risk of immune-mediated oral diseases and complications [4]. On the other hand, the long-term side effects of Antiretroviral Therapy also include oral

diseases and complications. A study among HIV exposed uninfected infants, showed that those on Lopinavir-ritonavir reported fewer impacts than those on Lamivudine [5].

Uganda continues to have a high burden of HIV with a prevalence of 6.2% among adults; 7.6% among women and 4.7% among men [6]. Among people living with HIV (PLWH) in Uganda, 65.5% are on antiretroviral therapy (ART) [6]. Although ART has improved the life expectancy among people living with HIV, more are prone to non-communicable diseases including dental caries. Oral and dental health remains a neglected area in most national and global health policy frameworks including HIV care; thus, contributing less than optimal overall health outcomes in this category of patients.

In Uganda, a national wide oral health survey report (2015) found that the prevalence of dental caries affected more than half (66%) of the nation's adults [7]. Similarly, another study found a high prevalence of 57.3% dental caries among adults in a rural community in central Uganda [8]. Other previous studies across Uganda also have demonstrated a high prevalence of dental caries of over 62.5% [9]. Dental caries has also been found to be prevalent among PLWH and has been associated with ART use. For example, Kalanzi (2019) using a cutoff point of DMFT > 0, found a prevalence of 83.7% dental caries in an adult urban population living with HIV [10]. ART use has also been associated with severe forms of dental caries [11], and yet dental caries has been implicated in pyogenic odontogenic infections [12] particularly in individuals with compromised immunity. In summary, current available literature has demonstrated high prevalence of dental caries among PLWH and ART use in an urban population. However, there is scant information on rural settings in Uganda where majority of Ugandans reside and access to dental care is different. As a result, the aim of this study is to determine the prevalence of dental caries among PLWH attending an adult outpatients HIV clinic in rural south-western Uganda.

Methods

Study design and setting

A cross-sectional study was conducted during May-June in 2017 at the adult HIV clinic of Mbarara Regional Referral Hospital (MRRH) located in Mbarara city, 275 km southwest of the capital city, Kampala. The study was done as part of an oral health status assessment of PLWH in rural south western Uganda. The MRRH HIV clinic has an enrollment of over 10,000 patients, and initiates approximately 1000 new patients on antiretroviral therapy (ART) each year. MRRH serves a catchment population of over 8,000,000 people drawn from 17 districts of rural Southwestern Uganda.

Ethical considerations

All participants provided written informed consent to participate in the study. A separate consent to review participants' clinical records was also obtained. For participants who were not formally educated and unable to read and write, informed consent was read to them verbatim in the local language of their preference. When they agreed to participate in the study, they were asked to append their thumb print to the informed consent form and the translator signed as a witness. The Mbarara University Research

Ethics Committee (MUST-REC) reviewed and approved the proposal, the approval number 17/02–17. Participants with dental treatment needs were referred to the dental unit at MRRH for management.

Inclusion criteria and recruitment

Adult patients aged 18 years and older receiving care at MRRH HIV clinic. And were either already taking or initiating ART. The selection was performed following a systematic sampling approach in which every fifth patient attending the clinic was included in the study. If a patient declined treatment or failed to meet the inclusion criteria, the subsequent patient was considered.

Data collection

An interviewer administered questionnaire with structured questions to collect data was used. Socio-demographic and clinical data were collected including age, gender, ART use and history, smoking history, alcohol use, brushing practices and dental caries using a modified World Health Organization (WHO) oral health questionnaire for adults [13]. The questionnaire was administered by trained research assistants.

Dental examinations were carried out by a trained and calibrated dental surgeon using disposable dental mirrors and probes under natural light. First, the number of missing teeth was noted, and surfaces of all teeth present were inspected for the presence or absence of dental caries, with or without fillings; and findings recorded on a dental chart. Caries were further classified using the decayed, missing, filled, teeth (DMFT) index [14]. Teeth that were traumatized or malformed, missing naturally, or extracted after trauma, existing periodontal disease or surgical intervention involving the mouth were excluded from classification. Those teeth which are filled because of dental caries were defined as having caries, whereas those restored following trauma or for cosmetic purposes were not. The respondents with toothache or dental caries were referred to the dental clinic for management, while those with missing teeth were advised to have dentures if necessary according to standard care of the Uganda Ministry of Health. All guidelines by the Uganda National Council of Science and Technology for conducting human participants research were fully adhered to.

Treatment needs assessment

We computed treatment needs by adding participants who had decayed and missing teeth and dividing by the total number of participants who had decayed, missing and filled teeth as previously used by Aleksejūnienė and Vilma Brukienė (2009) [15].

Income

We used an income of 1USD per day per person as a cutoff point for poverty [16].

Statistical methods

We conducted descriptive analyses on socio-demographic, oral health, and HIV characteristics of the cohort, then stratified by the presence or absence of dental caries. Estimated crude prevalence of dental caries and summarized DMFT index were obtained. Using fitted logistic regression models we identified

correlates of the presence of dental caries. Our predictor variables of interest included socio-demographic factors (age, sex, education and income), alcohol and tobacco use, dental health practices (number of times meals were eaten, frequency of brushing and dental checkups), dietary habits (eating snacks between meals) and HIV medical history (ART use, current CD4 count and CD4 at the time of initiation of ART). **Variables with significance of $p < 0.25$ in univariable and multivariable adjusted models** were included. Analyses were conducted with **STATA version 13**.

Results

Social demographic characteristics, ART usage and CD4 counts of the study participants

This study enrolled 194 participants, with a median age of 42 (IQR 36–49) years, the majority were female (64%, 124/194), and the median ART duration was 8 (IQR 8–12) years. A majority of participants had CD4 count more than 350cells/ μ l (78%, 152/194). Most participants reported having two meals per day (54%, 105/194) and brushing their teeth at least once a day (86%, 167/194). Most of our participants did not smoke (93%, 180/194) nor drink (80%, 156/194). More still, the majority (78%, 152/194) engaged in snacking and most (91%, 176/194) had never visited a dentist for dental checkup (see Table 1).

Table 1
 Characteristics of participants according to presence or absence of dental caries (N = 194)

Characteristic	No Dental caries (n %)	Dental caries (n %)	P-value
Age Categories			
<36	12(18.8)	35(26.9)	0.290
36–45	25(39.1)	46(35.4)	
>45	27(42.2)	49(37.7)	
Gender (n %)			
Female	39(60.9)	85(65.4)	0.544
Male	25(39.1)	45(34.6)	
Education (n %)			
None	9(14.1)	16(12.3)	0.293
Primary	39(60.9)	66(50.8)	
Secondary	10(15.6)	33(25.4)	
Certificate	3(4.7)	10(7.7)	
Diploma	3(4.7)	5(3.9)	
Occupation (n %)			
Formal Employment	5(7.8)	15(11.5)	0.591
Business	6(9.4)	9(6.9)	
Causal worker	34(53.1)	51(39.2)	
Self employed	19(29.7)	55(42.3)	
CD4 Count			
<=350	8(12.5)	34(26.2)	0.034
>350	56(87.5)	96(73.8)	
Meals per day			
Once	6(9.4)	12(9.2)	0.665
Twice	38(59.4)	67(51.5)	
Thrice	18(28.1)	48(36.9)	
>3 times	2(3.1)	3(2.3)	

Characteristic	No Dental caries (n %)	Dental caries (n %)	P-value
Tooth brushing habits			
No	13(20.3)	14(10.8)	0.075
At least once a day	51(79.7)	116(89.2)	
Alcohol use (n %)			
No	49(76.6)	107(82.3)	0.343
Yes	15(23.4)	23(17.7)	
Smoking (n %)			
No	59(92.2)	121(93.1)	0.822
Yes	5(7.8)	9(6.9)	
Ever had a dental Checkup			
Never	58(90.6)	118(90.8)	0.903
Once	6(9.4)	10(7.7)	
Twice	0(0)	1(0.8)	
3 + times	0(0)	1(0.8)	
Eating Snacks			
No	12(18.7)	30(23.1)	0.491
Yes	52(81.3)	100(76.9)	
Use of other Drugs			
No	59(92.2)	113(86.9)	0.277
Yes	5(7.8)	17(13.1)	

Prevalence, Dmft And Oral Treatment Needs

We found about two thirds of the participants (67%, 130/194) (95%CI 0.603–0.737) had dental caries using a DMFT > 0 (see Table 2). The median DMFT index score was 4 (IQR 2–6). The decayed component was 113 (median 2, IQR 2–3), missing 79 (median 2, IQR 1–4), filled 8 (median 2.5, IQR 1–3.5).

Table 2
DMFT and oral treatment needs among people living with HIV in southwestern Uganda

Characteristic (n %)	Decayed	Missing	Filled	Mean DMFT*	Treatment need	P-value
Age categories						
< 36	31(27.4)	18(22.8)	4(50)	3.0	96.0%	0.404
36–45	42(37.2)	30(38.0)	2(25)	3.4	99.4%	
> 45	40(35.4)	31(39.2)	2(25)	2.6	98.5	
Gender						
Male	35(31.0)	27(34.2)	1(12.5)	2.4	98.7%	0.121
Female	78(69.0)	52(65.8)	7(87.5)	3.3	97.9%	
Education						
None	16(14.2)	9(11.4)	2(25.0)	2.8	100%	0.927
Primary	58(51.3)	38(48.1)	0(0)	3.0	99.1%	
Secondary	28(24.8)	22(27.9)	3(37.5)	3.4	97.6%	
Certificate	7(6.2)	7(8.9)	1(12.5)	2.6	96.0%	
Diploma	4(3.5)	3(3.8)	2(25.0)	2.4	88.2%	
Occupation						
Formal Employment	14(12.39)	7(8.9)	2(25.0)	2.6	97.2%	0.813
Business	7(6.2)	4(5.1)	1(12.5)	2.4	100%	
unskilled worker	46(40.7)	33(41.8)	1(12.5)	3.0	99.0%	
Self employed	46(40.7)	35(44.)	4(50.0)	3.2	97.4%	
CD4 Count						
<=350	27(23.9)	21(26.6)	2(25.0)	3.3	99.2%	0.570
> 350	86(76.1)	58(73.4)	67(75.0)	2.9	97.8%	
Meals per day						

*DMFT; Decayed Missing, and Filled teeth

Characteristic (n %)	Decayed	Missing	Filled	Mean DMFT*	Treatment need	P-value
Once	10(8.9)	8(10.1)	4(50.0)	3.2	100%	0.946
Twice	57(50.4)	42(53.2)	0(0)	2.9	99.1%	
Thrice	44(38.9)	26(32.9)	3(37.5)	3.1	97.4%	
> 3 times	2(1.8)	3(3.8)	1(12.5)	3.8	83.3%	
Tooth brushing habits						
No	13(11.5)	6(7.6)	0(0)	1.9	100%	0.093
At least once a day	100(88.5)	73(92.4)	8(100)	3.2	98.0%	
Alcohol use						
No	95(84.1)	65(82.3)	7(87.5)	3.1	97.9%	0.510
Yes	18(15.9)	14(17.7)	1(12.5)	2.7	99.6%	
Smoking						
No	106(93.8)	74(93.7)	8(100)	3.1	98.0%	0.354
Yes	7(6.2)	5(6.3)	0(0)	2.1	100%	
Ever had a dental Checkup						
Never	104(92.0)	68(86.1)	6(75.0)	3.0	98.5%	0.169
Once	7(6.2)	9(11.4)	1(12.5)	2.9	98.3%	
Twice	1(0.9)	1(1.3)	0(0)		100%	
3 + times	1(0.9)	1(1.3)	1(12.5)		60%	
Eating Snacks						
No	26(23.0)	16(20.3)	0(0)	2.8	100%	0.728
Yes	87(77.0)	63(79.7)	8(100)	3.1	97.6%	
Use of other Drugs						
No	101(89.4)	70(88.6)	7(87.5)	3.1	97.9%	0.231
Yes	12(10.6)	9(11.4)	1(12.5)	2.1	100%	
*DMFT; Decayed Missing, and Filled teeth						

Bivariate And Multivariate Analysis

In the bivariate analysis, the only result that was significant is CD4 count with (CI **0.175–0.932**, P 0.034) meanwhile in multivariate analysis there were no significant results (see Table 3).

Table 3
Logistic regression models for correlates of dental carries among people with HIV

Characteristics	Bi-variate Analysis			Multivariate Analysis		
	OR	CI	P-value	AOR	CI	P-values
Age	0.987	0.957–1.017	0.399	0.982	0.947–1.020	0.362
Gender	0.826	0.445–1.533	0.544	0.852	0.413–1.757	0.664
Education	1.196	0.856–1.671	0.293	1.269	0.845–1.907	0.250
Occupation	1.091	0.793–1.501	0.591	1.235	0.863–1.769	0.248
ART	0.816	0.320–2.081	0.671	1.104	0.330–3.690	0.872
ART Duration	0.971	0.919–1.027	0.307	0.987	0.916–1.062	0.725
CD4 Count	0.403	0.175–0.932	0.034*	0.427	0.172–1.063	0.067
Meals per day	1.179	0.751–1.849	0.475	1.098	0.665–1.811	0.715
Tooth brushing habits	2.112	0.927–4.813	0.075	1.811	0.748–4.384	0.188
Income	1.0	1–1	0.267	1.0	1.0–1.0	0.148
Alcohol use	0.702	0.337–1.462	0.345	0.614	0.255–1.478	0.277
Smoking	0.878	0.282–2.735	0.822	1.190	0.294–4.809	0.807
Dental Checkup	1.179	0.504–2.761	0.704	0.995	0.409–2.425	0.992
Eating Snacks	0.769	0.364–1.626	0.492	0.759	0.332–1.732	0.512
Use of other Drugs	1.775	0.624–5.051	0.282	1.960	0.587–6.550	0.274

Discussion

Our study is one of the first to determine the prevalence, correlates and treatment needs of dental caries among PWH in Uganda. Our findings highlight the high prevalence of DMFT among the study population at 67%, (130/194), 95% CI (60–75%) with the decayed component among those with dental caries experience being very high (113/130, 86.9%) and an association between lower CD4 and dental caries. The results also reveal a gap in prevention needs of over 90% among the participants as these had never had a dental checkup despite having dental caries. The gap between the decayed teeth (DT) 113 and filled teeth (FT) (8) is a clear demonstration of possible inadequacies in knowledge, availability or access to dental services that require further investigations. Most of the variables including socio-demographic characteristics, gender, life style, and ART duration were not associated with dental caries. The

observation above might be resulting from the relatively small sample size of only 194 participants or this being a cross sectional study.

In this study majority of the participants were females (63.9%) and young with 60.8% aged 45 years and below. Majority had primary or no formal education. In many aspects, our findings are similar to what was found in an urban population in Uganda on ART [10] in which the majority of participants (65.6%) were female and were young with mean age of 39 years. In another study on women living with HIV and on ART carried out in Eastern Uganda, those who had dental caries, were also young with mean age of 35 years [17]. The findings of more women participants in our study can be explained by the fact that in this setting, women tend to seek care more than men. This is reflected in other sub-Saharan African countries where women with HIV tend to enroll more in ART than the men living with HIV. Worse still men tend to report at stage IV of HIV [18–20].

Two thirds of our study participants (67%) had dental caries (DMFT > 0). There was a higher overall prevalence of dental caries in women (n = 85, 65.4%) compared to men (n = 45, 34.6%). This is similar to those found by Kalanzi et al (2019) who found a high overall prevalence of 83.7% and a higher prevalence among females 86.6% than males 78.2%[10]. Birungi and others (2021) also found a high prevalence of dental caries (81%) in a rural population of HIV positive women [17]. The reasons as to why women in this study population have a higher prevalence of dental caries than men are not clear but may be due to differences in snacking, oral hygiene and dietary habits thus a need for further research in this area. The high prevalence of dental caries in our study is a reflection of the general population probably due to lack of preventive and curatives oral services.

Surprisingly, we found a statistically significant (P = 0.034) higher prevalence (n = 96, 73.8%) of dental caries among those with a higher CD4 count (> 350 cells/ μ L) compared to those with a lower CD4 count (N = 34, 26.2%). This is an area that requires further exploration to investigate the conflicting role of ART in dental caries.

Our findings reveal a large prevention need as demonstrated by a high proportion of participants who have never gone for a checkup (n = 176, 90.7%) and of these 90.8% had caries. Furthermore, we found a high overall oral treatment need of 96% as the number of patients with decayed and /or missing teeth had never had them filled or replaced. Additionally, 13.9% never brushed their teeth at all this call for need for oral health education intervention. Among participants with dental caries (DMFT < 0) 113 had decayed teeth which were not filled and 79 had missing teeth which were not replaced. This further raises a need for a large scale survey among people on ART to generate stronger evidence for integrating dental and oral health into HIV care. Besides the evidence from a low filled (8) component of DMFT index despite a high decay (113) component is strong indication for lack of individual dental care for the patient as decaying teeth are ignored. To mitigate this glaring disparity, there is need to include dental and oral health care services in the national guidelines for HIV care.

The limitations of our study include the fact that this work was conducted in a high volume clinic in a single regional referral hospital. It would be interesting to conduct a similar study at primary health care

facility using a larger population and also to include a non HIV comparison group.

Conclusions

We identified a high prevalence and treatment needs of dental caries in PLWH on ART in rural southwestern Uganda, where there is an absence of preventive and therapeutic care for oral health. Consequently, we recommend inclusion of dental and oral care in routine HIV care services in the region.

Declarations

Ethics approval and consent to participate:

All participants provided written informed consent to participate in the study. A separate consent to review participants' clinical records was also obtained. For participants who were not formally educated and unable to read and write, informed consent was read to them verbatim in the local language of their preference. When they agreed to participate in the study, they were asked to append their thumb print to the informed consent form and the translator signed as a witness. All guidelines by the Uganda National Council of Science and Technology for conducting human participants research were fully adhered to. The Mbarara University Research Ethics Committee (MUST-REC) reviewed and approved the proposal, the approval number 17/02-17.

Consent for publication: Participants consented to the publication of the information obtained from them.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author SM on reasonable request. All data generated or analysed during this study are included in this published article.

Competing interests: The authors declare that they have no competing interest.

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Authors' contributions

WA, GK, DT and SM conceptualized, and designed the study, WA and GK, implemented data collection, WA, GK, DT, MK, and MJS analysed data, MK did statistical analyses, WA, GK, DK MJS, VN, SC, BAS and JNN wrote the manuscript. All authors read and approved the final manuscript.

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References

1. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, Murray CJ: **Global burden of oral conditions in 1990–2010: a systematic analysis**. *Journal of dental research* 2013, **92**(7):592–597.
2. World Health Organisation: **Oral health fact sheet**. In. Geneva; 2021.
3. Dye B: **The global burden of oral disease: research and public health significance**. *Journal of dental research* 2017, **96**(4):361–363.
4. Khoury ZH, Meeks V: **The influence of antiretroviral therapy on HIV-related oral manifestations**. *Journal of the National Medical Association* 2021, **113**(4):449–456.
5. Birungi N, Fadnes LT, Engebretsen IMS, Tumwine JK, Åstrøm AN: **Antiretroviral treatment and its impact on oral health outcomes in 5 to 7 year old Ugandan children: A 6 year follow-up visit from the ANRS 12174 randomized trial**. *Medicine (Baltimore)* 2020, **99**(39):e22352.
6. Ministry of Health Uganda: **Uganda Population-Based HIV Impact Assessment**. In. Kampala; 2017.
7. Kutesa A, Kasangaki A, Nkamba M, Muwazi L, Okullo I, Rwenyonyi CM: **Prevalence and factors associated with dental caries among children and adults in selected districts in Uganda**. *African health sciences* 2015, **15**(4):1302–1307.
8. Rwenyonyi CM, Muwazi LM, Buwembo W: **Assessment of factors associated with dental caries in rural communities in Rakai District, Uganda**. *Clinical oral investigations* 2011, **15**(1):75–80.
9. Muwazi LM, Rwenyonyi CM, Tirwomwe FJ, Ssali C, Kasangaki A, Nkamba ME, Ekwaru P: **Prevalence of oral diseases/conditions in Uganda**. *Afr Health Sci* 2005, **5**(3):227–233.
10. Kalanzi D, Mayanja-Kizza H, Nakanjako D, Mwesigwa CL, Ssenyonga R, Amaechi BT: **Prevalence and factors associated with dental caries in patients attending an HIV care clinic in Uganda: a cross sectional study**. *BMC Oral Health* 2019, **19**(1):159.
11. Kalanzi D, Mayanja-Kizza H, Nakanjako D, Sewankambo NK: **Extensive dental caries in a HIV positive adult patient on ART; case report and literature review**. *BMC Oral Health* 2018, **18**(1):205.
12. Kityamuwesi R, Muwaz L, Kasangaki A, Kajumbula H, Rwenyonyi CM: **Characteristics of pyogenic odontogenic infection in patients attending Mulago Hospital, Uganda: a cross-sectional study**. *BMC microbiology* 2015, **15**:46.
13. World Health Organization: **Oral health surveys: basic methods**: World Health Organization; 2013.
14. World Health Organization: **Oral health survey: basic methods 5th ed**. *Geneva, Switzerland: WHO* 2013.
15. Aleksejūnienė J, Brukienė V: **An assessment of dental treatment need: an overview of available methods and suggestions for a new, comparative summative index**. *Journal of public health dentistry* 2009, **69**(1):24–28.
16. Owori M: **Poverty in Uganda: National and regional data and trends**. Development Initiatives <https://devinit.org/resources/poverty-uganda-national-and-regional-data-and-trends> 2020.

17. Birungi N, Fadnes LT, Engebretsen IMS, Tumwine JK, Lie SA, Åstrøm AN: **Caries experience by socio-behavioural characteristics in HIV-1-infected and uninfected Ugandan mothers – a multilevel analysis.** *Acta Odontologica Scandinavica* 2021:1–8.
18. Auld AF, Shiraishi RW, Mbofana F, Couto A, Fetogang EB, El-Halabi S, Lebelonyane R, Pilatwe PT, Hamunime N, Okello V: **Lower levels of antiretroviral therapy enrollment among men with HIV compared with women—12 countries, 2002–2013.** *Morbidity and Mortality Weekly Report* 2015, **64**(46):1281–1286.
19. Centers for Disease C, Prevention: **Differences between HIV-Infected men and women in antiretroviral therapy outcomes - six African countries, 2004–2012.** *MMWR Morb Mortal Wkly Rep* 2013, **62**(47):945–952.
20. Giles ML, Achhra AC, Abraham AG, Haas AD, Gill MJ, Lee MP, Luque M, McGowan C, Cornell M, Braitstein P: **Sex-based differences in antiretroviral therapy initiation, switching and treatment interruptions: global overview from the International Epidemiologic Databases to Evaluate AIDS (IeDEA).** *Journal of the International AIDS Society* 2018, **21**(6):e25149.