Effects of ART on the Oral Health of HIV-Infected Children and Adolescents in Kenya

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Abstract

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Purpose: To determine the prevalence of HIV oral manifestations and oral comorbidities in ART treated children and adolescents, and its relationship with oral health status at the time initiation of ART.

Methods: We utilized convenience sampling of a population nested into ongoing cohort studies of 78 Kenyan HIV-infected children who were enrolled and initiated antiretroviral therapy (ART) as part of two clinical trials. Oral health examinations were performed by Community Oral Health Officers (COHO's) to determine oral health endpoints. Demographics, age at initiation of ART, HIV diagnosis, baseline CD4, and HIV RNA viral load data were extracted from the primary study databases. Fisher's exact and two-sample t-tests were run to examine the significance of the differences observed between early and late ART initiation groups.

Results: The majority of children and adolescents evaluated in this study were found to have at least one type of oral disease (83.3%). When compared to children with early art initiation, children with late art initiation showed decreased odds of having dental caries (OR:0.55 CI:0.20, 1.48; p=0.23), decreased odds of presenting with any HIV-associated oral lesion when compared to early ART initiation (OR: 0.57; CI:0.18, 1.62; p= 0.31) and the mean dmft/DMFT (adjusted model; ß:-1.23; CI:-7.7, 4.90; p=0.69).

Conclusion: Oral disease is highly prevalent in Kenyan CALHIV despite having access to high quality medical care at the Kenyatta National Hospital. Oral disease prevalence varies by age at initiation of ART and should be investigated further on an individual basis. This study highlights the opportunity for integrating oral health in pediatric HIV medical, boosting interprofessional collaboration in the effort to improve the quality of life of CALHIV.

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To **Dr. Ana Lucia Seminario**, my senior investigator, thank you for being such a great role model and mentor, through your guidance and dedication to global oral health research you have shown me how I can make a positive impact in this world.

DEDICATION

I dedicate my thesis to my nieces and nephews: Je'Annie, Nathan, Armani, Amayrani, Genesis, Aurora, Gael, and Gian. I love you all from the bottom of my heart. You inspire me to take care of children, as I would want people to take care of you. I hope I can inspire you to do something you love as well. Your possibilities are endless.

BACKGROUND

In the era of antiretroviral therapy (ART), HIV continues to be a worldwide public health burden. [1] By the end of 2019, the prevalence of HIV infection had increased from 33 million to 38 million people, with youth and adolescents being the most affected. [2] In the United States, 13-24 year-olds made up twenty-one percent of all new HIV diagnoses and by end of 2018, approximately 1,900 children younger than the age of 13 years were diagnosed with HIV.[3,4] This issue is not unique to the American youth. In 2019 the United Nations Children's Fund (UNICEF) reported that adolescents and young people made up a growing portion of the people living with HIV and 1.8 million children 0-14 years old were living with HIV globally.[1 5]

Children and adolescents living with HIV (CALHIV) are at a higher risk for oral opportunistic infections and comorbidities than non-HIV infected youth. Major associated oral diseases include but are not limited to oral candidiasis, angular cheilitis, herpes simplex virus, recurrent aphthous ulcers, and parotid gland enlargement. Dental co-morbidities include dental caries and periodontal disease.[6,7,8] Although medications generally improve symptoms associated with any given disease, drugs might have the potential to exacerbate comorbidities. Specifically, ART is believed to increase the risk of certain oral diseases by decreasing salivary flow, which plays a key role in disease prevention due to saliva's buffering capacity and antimicrobial properties. [9]

There are limited studies that have assessed the effects of ART and oral health among children and adolescents. A literature report in 2013 showed that no specific data on the severity of oral diseases in this population with HIV had been presented.[10] Since then, very few studies evaluating the effects of ART on the oral health of CALHIV have been published. In 2016, the Pediatric HIV/AIDS Cohort Study (PHACS), compared the prevalence of caries amongst

perinatally HIV (PHIV) infected youth and perinatally HIV-exposed but uninfected (PHEU) youth. This study reported that while the prevalence of HIV associated oral mucosal lesions decreased significantly, dental caries and periodontal disease remained high in patients treated with ART.[11] [12] A PHAC study in 2018 evaluated how various ART regimens and the age of first exposure to ART affected the oral health of PHIV adolescents. Results showed that 61% of PHIV subjects had untreated dental caries, and that there was an association with the type of medications used in ART and a subject's caries experience. Severity of dental caries was measured by using the mean decayed, missing, filled teeth (DMFT) scores for patients who initiated ART at <2 years old, 2-5 years old, and 6 years old. A subject's DMFT score is the sum of decayed, missing due to caries, and filled teeth.[13] The DMFT Scores were 3.9, 5.6, and 7.5 respectively.[8]

While studies on American cohorts have given insights on how ART is affecting PHIV children and adolescents, there is a lack of studies on robust long-term, clinical cohorts to inform how ART has affected the oral health status of CALHIV in developing countries. Because developing countries with a high burden of HIV have experienced few interventions targeting the oral health of CALHIV, studies in these geographical settings are highly relevant. Currently, 89% of the 1.6 million adolescents affected by HIV reside in Sub-Saharan Africa.[1] In Kenya, roughly 5.6% of the population is HIV infected, with approximately 150,000 of these individuals being children and adolescents.[14] Understanding the prevalence of HIV-related oral diseases and dental comorbidities in ART treated Kenyan CALHIV, will inform healthcare professionals and stakeholders of the relevance of integrating oral health within the primary care of CALHIV. The Kenyatta National Hospital, the University of Nairobi, and the University of Washington have joined efforts to integrate oral health within their long-standing clinical HIV pediatric research in Kenya. This cross-sectional study aims to determine the prevalence of HIV oral manifestations

and oral comorbidities in ART treated children and adolescents, and to assess the relationship of oral health status with the time at initiation of ART. We hypothesize that prevalence of oral diseases in this population is high (over 50%) and varies by age of ART initiation. This study exemplifies how inter-professional collaboration between clinical HIV and oral health research could improve the quality of life in CALHIV.

METHODOLOGY

The cross-sectional study was approved by Institutional Review Boards at the University of Washington (STUDY00003298) and by the Kenyatta National Hospital/University of Nairobi Ethics Research Committee at the KNH/ERC/R/133).

Study Population: The Kenyan Pediatric Studies

In this study we used convenience sampling of a population nested into ongoing cohort studies of Kenyan HIV-infected children who were enrolled and initiated antiretroviral therapy (ART) as part of two clinical trials. All children were recruited, enrolled, and followed-up in the same study clinic at Kenyatta National Hospital, Nairobi, Kenya; details of their recruitment, enrollment, and clinical follow-up procedures are available elsewhere.[15,16] From 2007-2010, the Optimizing Pediatric HIV Therapy (OPH) study enrolled children <12 months old and started ART immediately, regardless of CD4 or clinical status and all children and have continued follow-up to evaluate long-term outcomes (NCT00428116).[15] The Pediatric Adherence Diary (PAD) Study[17] enrolled children older than 12-months old from 2004-2005 who met contemporaneous clinical criteria for ART initiation (*moderate (WHO clinical stage 2 with CD4 <15%) to severe (WHO clinical stage 3 or 4) HIV-1 disease)*. OPH and PAD children received ART regimens in accordance with contemporaneous guidelines. For OPH, and PAD demographic, clinical data from caregiver-child dyads (including demographics, maternal and child ART, virologic and CD4

and HIV RNA viral load were collected using standardized clinical assessments and questionnaires.

RECRUITMENT

Nurses, who work with the PAD and OPH Cohorts at the Kenyatta National Hospital HIV clinics, recruited families to participate in this oral health study. Parents/legal guardians provided written informed consent for their children to participate in the study. Every child over 8 years old assented to participating. In order to ensure comprehension of the study on behalf of the families, the information was provided in English and Swahili, allowing families to elect their preferred language. All nurses were fluent in both languages. No family declined participation.

DATA COLLECTION

Demographics, HIV diagnosis, baseline CD4 and HIV RNA viral load data were extracted from the primary study databases. Local Community Oral Health Officers (COHOs; dental therapists) performed all oral health examinations. The COHO's were trained and calibrated in the diagnosis of dental defects and oral manifestations of HIV, such as oral candidiasis, angular cheilitis, HSV ulcers, aphthous ulcers, parotid enlargement and ulcerative gingivitis. Calibration for diagnosing oral manifestations of HIV and dental defects was done in by following validated training modules provided by the UW and University of California-San Francisco.[18] The calibration was tested for accuracy showed an inter-rater reliability score of 0.78 and an intra-rater reliability of 0.85. Calibrated Kenyan COHO conducted oral examinations during routine HIV care visits. All examinations occurred onsite in a room adjacent to the HIV clinic, and which had been prepared for the purpose.

ORAL HEALTH ENDPOINTS

The evaluation of HIV associated oral mucosal lesions was performed in accordance with the WHO Oral Health Surveys and Record Form for Oral Manifestations of HIV/AIDS.[13] All oral diagnoses were recorded. The DMFT index depicts previous and current dental disease, while its subset the Decayed Teeth (DT) index only evaluates currently active diseases. DMFT also provides details on the severity of the caries in a child as it reflects the number of permanent teeth involved and missing due to caries lesions and dmft describes the same caries experience parameters applied to primary teeth.[13]

CLINICAL INDICATORS OF HISTORY OF AND CURRENT HIV DISEASE SEVERITY

HIV markers and general health variables were extracted from KPS medical records. HIV disease severity history was considered in the characterization of the study participants and in various analyses using the following clinical Indicators; viral load detectability (>400 copies/mL), and CD4 cell count nadir. Current HIV disease severity was considered in the characterization of the study sample and in various analyses using the following binary clinical indicators measured at or within 90 days of the oral study visit: HIV viral load (≤400 or >400 copies/mL), and CD4 cell count (<400 or ≥400 cells/mm3).

STATISTICAL PLAN

For this descriptive study dentition status and pertinent medical and HIV status was recorded on paper forms and was entered into and managed using Research Electronic Data Capture (REDCap) tools hosted at the UW. REDCap is a secure, web-based application designed to support data capture for research studies. Additional demographic data, including caregiver's sex, age, and highest educational degree received was collected as part of this project. Mean and standard deviation of continuous variables and counts and proportions of

categorical variables were calculated for all participants in the sample as well as stratified by children who initiated ART early (OPH study cohort) and late (PAD study cohort). The burden of oral disease and oral manifestations of HIV were also characterized for the overall sample and by ART initiation. Fisher's exact and two-sample t-tests were run to examine the significance of the differences observed between early and late ART initiation groups. To assess the association between ART initiation and caries experience, multivariable logistic regression and linear regression models were used. Logistic regression models were also used to examine the relationship of ART initiation with oral lesion presence and gingival inflammation. Gingival inflammation will be categorized dichotomously, with inflammation being present if bleeding on probing score is greater than or equal to 10%. Statistical significance was set at 5%, and R software version 3.6.0 was utilized for analyses (R Foundation for Statistical Computing, Vienna, Austria).

DEMOGRAPHICS AND HIV-RELATED ENDPOINTS

A total of 78 HIV-infected children were evaluated in this study, 51 children in the early ART initiation group (enrolled at 0-12 months of age), and 27 in the late ART with late ART group (enrolled 15 months to 12 years of age) (Table 1). The mean age of the study population at the time of the oral exam was 13.2 years (SD: 3.4) (early ART group 10.9 years (SD:0.6) vs. late ART group 17.5 years (SD:1.7)). Approximately, half of the children were female (47.4%) (early ART group 43.1% vs. late ART group 55.6%). The mean number of months on ART was 139.1 (SD: 20.6) (early ART group 125.4 (SD:7.6) vs. late ART group165.2 (SD: 8.5)). The majority of subjects were in mixed dentition (62.8% vs. 37.2% in permanent dentition). At the time of oral exam, 16.7% of all children were found to have detectable viral loads (early ART group 19.6% vs. late ART group 11.1%). and the mean baseline HIV viral load amongst all the children was

14.4 $\log_{10}$ HIV RNA copies/ml (SD: 2.3) (early ART group 15.1 (SD:1.7) vs. late ART group 13.4 (SD:2.6)). Children's mean CD4 counts at the time of enrollment were 1068.2 cells/mm^3 (SD: 728.9) and 1050.7 (SD:531.2) cells/mm^3 at the time of the oral exam. Regarding children's household information, the mean number of children per family was 2.1 (SD: 1.1). Of the 74 parents/caregivers who presented with the children, 87.2% were females. At the time of evaluation, the mean age for caregivers was 39.2 years (SD:8.1) (early ART group 37.6 (SD:7.5) vs. late ART group 42.5 (SD:8.5)), and their mean education years of 10.1 years (SD: 2.9) (early ART group 9.9 (SD:3.1) vs. late ART group 10.3 (SD:2.8)).

PREVALENCE OF ORAL DISEASES

The majority of children and adolescents evaluated in this study were found to have at least one type of oral disease (83.3%). Differences in the prevalence of oral diseases by ART group was not significant (early ART 82.4% vs. late ART 85.2% ($p>0.9$)). Dental caries was the most common oral disease found in this study population (67.9%); children and adolescents within the early ART group being most affected (72.5% vs. 59.3%; $p=0.3$). Mean dmft/DMFT scores was higher among subjects with late ART compared to early ART initiation (2.8 (SD: 3.0) vs.2.5 (SD:2.4); ($p=0.7$)). Other oral diseases included fluorosis, gum disease, dry mouth and ulcers unrelated to HSV or aphthous ulcers. Dental fluorosis was found in 29.4% of the early ART initiation group, and in 37% of the late ART initiation group ($p=0.6$). Dry mouth was found in 29.4% of the early ART initiation group, and in 14.8% of the late ART initiation group ($p=0.4$). The least common oral pathology were ulcers unrelated to HSV or aphthous ulcers with a prevalence of 6.4% (7.8% early ART vs. 3.7% late ART initiation group ($p=0.7$)) (Table 2).

ORAL DISEASES AND RELATED VARIABLES

Further analysis of oral pathologies (other ulcers (not HSV/Aphthous ulcer, dry mouth, fluorosis and gingival inflammation) showed that late ART initiation decreased odds of presenting with any HIV-associated oral lesion when compared to early ART initiation (OR: 0.57; CI:0.18, 1.62; p= 0.31). We did not find significant association of child's age, CD4 percent at the time of the oral exam (OR:0.93; CI:0.79,1.06; p=0.35), baseline HIV $\log_{10}$ viral load (OR:0.97; CI:0.56,1.76; p=0.92) and caregivers' age at the time of the exam (OR: 0.95; CI:0.89, 1.02; p=0.17) with the presence of oral pathologies. PMTCT appeared to increase the odds for oral diseases (OR:1.14; CI:0.38, 3.59; p=0.81). Yet the adjusted model changed the direction of the association (OR:0.63; CI:0.09, 4.10; p=0.63).

DISCUSSION

In this nested cross-sectional study, we aimed to assess the burden of oral diseases in HIV-infected children and adolescents receiving care at the Kenyatta National Hospital. We also explored relationships between the time at ART initiation and the occurrence of HIV oral manifestations and oral comorbidities. Our results show that oral diseases (83.3%) were substantially prevalent. Although this cohort was well integrated into a healthcare system, with healthcare visits every three months, prevalence of caries in our study population (67.9%) was significantly higher when compared to the general Kenyan pediatric population (23.9%).[19] Studies on children from other African countries such as Mali, Senegal, and Côte d'Ivoire have indicated that sweetened medications, cariogenic diets, a limited dental workforce, and medication induced hyposalivation are associated with high prevalence of caries in ART treated children (86%).[20] Similar results have been found in the PHAC Cohort which identified a high

prevalence of dental caries in American ART treated children (61%).[11] Despite the many successes in managing HIV in children and adolescents, the high prevalence of dental caries calls for further research identifying key preventive interventions to reduce disease onset and therefore improve quality of life of CALHIV.

Hyposalivation is another condition that was prevalent in our study population (24.4%). Low salivary flow is a known risk factor for dental caries, oral candidiasis and traumatic ulcers.[21]. Adequate saliva levels helps mitigate the cariogenic activity of oral acids by diluting the acid in the mouth.[22] It has been shown that patients infected with HIV are at a high risk for hyposalivation, as a result of the infection infiltrating the salivary gland and the reduced salivary flow from the use of ART.[22,23] Non-specific HSV/aphthous ulcers were observed in this study (6.4%), this may be due to the salivary dysfunction yielding less lubrication for the oral soft tissue therefore increasing the risk for traumatic ulcers. [21] Our results are similar to that of HIV infected adults that have found that ART is associated with lower salivary flow.[24]

When evaluating caries as it associates with age at initiation of ART, we found that children with early ART initiation (age <12 months) had a higher prevalence than children with late ART initiation (15 months to 12 years old), suggesting that children with late ART initiation had lower odds of experiencing caries than the early ART group (OR: 0.55; CI: 0.20,1.48). Since the early ART initiation group has been exposed to ART for a longer time, this finding may be explained by the effect of ART decreasing salivary flow, and hyposalivation being strongly associated with increased caries risk. [9] This finding is supported by a study performed on an adult cohort in Thailand in which subjects with long term ART utilization showed a higher prevalence of cervical caries than subjects with short term ART utilization.[25] Confounding variables may have contributed to the prevalence of caries in each group. For example, the

children in the early ART initiation group were mostly in their mixed dentition (94.1%) while the majority of subjects in the late ART group were in their permanent dentition (96.3%). This is important because children in the mixed dentition have been found to be at a relatively high risk for caries. [26] This may be because the enamel in primary teeth is thin and more prone to caries and in the mixed dentition these teeth are exposed to cariogenic insults for a longer time. [26]

The results of this study may have been affected by limitations. This study was a cross-sectional study with a relatively small sample size. Being the first of its kind within the KPS cohort, we were limited to the length of time we had available for interacting with study individuals. Medical care appointments of people living with HIV often are long. Children and adolescents often experience distress in healthcare settings, and this can be exacerbated by increased length and frequency of appointments.[27] Because oral examinations immediately followed medical visits, there were time limitations preventing further inquiry on factors such as diet, oral hygiene, and oral health related behaviors. Additionally, data on gingival inflammation is limited. We followed the WHO Guidelines for periodontal assessments that included gingival probing on children 12 years and older. It is our intention to conduct this secondary data analysis on periodontal disease and how it correlates with general inflammation. By identifying the prevalence of various oral health conditions in CALHIV, this study highlights the importance of integrating oral heath to the comprehensive care of this population and identifies potential areas for future studies in interprofessional care for CALHIV.

CONCLUSION

The findings from this study demonstrate that despite being on ART and receiving regular medical care at a highly specialized institution, CALHIV have substantially high occurrence of

oral diseases. We also showed that the distribution of oral diseases varies by the age at ART initiation suggesting that the biological mechanism of each oral disease should be further investigated on an individual case rather than as a group. This study highlights the opportunity for integrating oral healthcare within pediatric HIV medical care, therefore boosting inter-professional collaboration and improving the quality of life of CALHIV.

Table 1: Demographics and Dental Health Status of Children in KPS Cohort and Caregivers.

Demographics	Total (N = 78)	Early ART Initiation* (N = 51)	Late ART Initiation* (N = 27)
	N (%)	N (%)	N (%)
Sex			
Female	37 (47.4)	22 (43.1)	15 (55.6)
Male	41 (52.6)	29 (56.9)	12 (44.4)
Dentition Status			
Mixed dentition	49 (62.8)	48 (94.1)	1 (3.7)
Permanent Dentition	29 (37.2)	3 (5.9)	26 (96.3)
Detectable viral load at oral exam	13 (16.7)	10 (19.6)	3 (11.1)
	Mean (SD)	Mean (SD)	Mean (SD)
Age (years)			
At enrollment	1.8 (1.8)	0.8 (0.8)	3.7 (1.5)
At oral exam	13.2 (3.4)	10.9 (0.6)	17.5 (1.7)
Caregiver Information			
Parent sex			
Female	68 (87.2)	47 (92.2)	21 (77.8)
Male	6 (7.7)	3 (5.9)	3 (11.1)
Caregiver age (years)	39.2 (8.1)	37.6 (7.5)	42.5 (8.5)
Caregiver Education (years)	10.1 (2.9)	9.9 (3.1)	10.3 (2.8)
CD4 Count			
At ART initiation	1,068.2 (728.9)	1,329.0 (677.9)	604.6 (576.7)
At oral exam	1,050.7 (531.2)	1,115.2 (557.8)	928.9 (462.2)
Baseline log_{10} Viral Load	14.4 (2.3)	15.1 (1.7)	13.4 (2.6)
Months on ART	139.1 (20.6)	125.4 (7.6)	165.2 (8.5)
Number of children per family	2.1 (1.1)	2.2 (1.1)	1.6 (0.8)
Mother with PMTCT	39 (50.0)	37 (72.5)	2 (7.4)

*Early ART Initiation = enrolled at 0-12 months of age; Late ART Initiation = enrolled 15 months to 12 years of age

Table 2: Oral Diseases in Patients with Early ART Initiation and Late ART Initiation.				
Oral Conditions	**Total**	**Early ART Initiation***	**Late ART Initiation***	**P-Value**
	N(%)	N(%)	N(%)	
Any Oral Condition	65 (83.3)	42 (82.4)	23 (85.2)	>0.9
Other Ulcer (not HSV/aphthous ulcer)	5 (6.4)	4 (7.8)	1 (3.7)	0.7
Dry Mouth	19 (24.4)	15 (29.4)	4 (14.8)	0.4
Gum Disease	18 (23.1)	10 (19.6)	8 (29.6)	0.4
Fluorosis	25 (32.1)	15 (29.4)	10 (37.0)	0.6
Dental Caries	53 (67.9)	37 (72.5)	16 (59.3)	0.3
	Mean (SD)	Mean (SD)	Mean (SD)	
dmft/DMFT	2.6 (2.6)	2.5 (2.4)	2.8 (3.0)	0.7

*Early ART Initiation =enrolled at 0-12 months of age; Late ART Initiation = enrolled 15 months to 12 years of age

Table 3: Correlates of HIV and Dental Caries								
	Dental Caries (Yes/No)				**dmft/DMFT Score**			
	Unadjusted Odds Ratio (95% CI)	P-value	Adjusted* Odds Ratio (95% CI)	P-value	Unadjusted Slope (95% CI)	P-value	Adjusted* Slope (95% CI)	P-value
ART Initiation								
Early ART	Ref		Ref		Ref		Ref	
Late ART	0.55 (0.20, 1.48)	0.23	0.15 (0.001, 36.5)	0.49	0.27 (-0.97, 1.50)	0.43	-1.23 (-7.7, 4.90)	0.69
Child's age								
Continuous	0.94 (0.82, 1.09)	0.40	1.09 (0.52, 2.26)	0.82	0.05 (-0.13, 0.22)	0.61	0.09 (-0.74, 0.93)	0.83
CD4 Percent At Time of Exam								
Continuous	1.01 (0.95, 1.07)	0.74	1.08 (0.98, 1.22)	0.16	0.004 (-0.07, 0.08)	0.91	-0.01 (-0.13, 0.11)	0.85
Baseline HIV $\log_{10}$ Viral Load								
Continuous	0.81 (0.42, 1.42)	0.49	0.75 (0.31, 1.56)	0.47	-0.72 (-1.33, -0.10)	0.02	-0.84 (-1.68, -0.008)	0.0498
Caregiver Education								
Continuous	0.94 (0.79, 1.12)	0.50	0.96 (0.71, 1.28)	0.79	0.11 (-0.11, 0.33)	0.31	0.17 (-0.13, 0.46)	0.25
Caregiver's Age At Time of Exam								
Continuous	1.00 (0.94, 1.07)	0.96	0.94 (0.83, 1.06)	0.33	0.02 (-0.05, 0.10)	0.57	0.01 (-0.12, 0.13)	0.93
Mother received ART during pregnancy with child								
No	Ref	-	Ref	-	Ref	-	Ref	-
Yes	0.78 (0.25, 2.30)	0.65	0.39 (0.04, 2.31)	0.33	-0.91 (-2.25, 0.44)	0.18	-1.24 (-3.21, 0.73)	0.21

* Adjusted for every other variable in the table (make font smaller)

Table 4: Correlates of Oral Diseases.				
	Any Oral Lesions Gingival Inflammation			
	Unadjusted Odds Ratio (95% CI)	P-value	Adjusted* Odds Ratio (95% CI)	P-value
ART Initiation				
Early ART	Ref		Ref	
Late ART	0.57 (0.18, 1.62)	0.31	1.25 (0.0003, 10762.9)	0.96
Child's age				
Continuous	0.93 (0.79, 1.08)	0.35	0.56 (0.10, 1.75)	0.42
CD4 Percent At Time of Exam				
Continuous	0.99 (0.93, 1.05)	0.79	1.06 (0.94, 1.20)	0.34
Baseline HIV $\log_{10}$ Viral Load				
Continuous	0.97 (0.56, 1.76)	0.92	0.57 (0.22, 1.32)	0.19
Caregiver Education				
Continuous	1.00 (0.83, 1.20)	0.99	1.12 (0.85, 1.48)	0.42
Caregiver's Age At Time of Exam				
Continuous	0.95 (0.89, 1.02)	0.17	0.93 (0.81, 1.04)	0.24
Mother received ART during pregnancy with child				
No	Ref	-	Ref	-
Yes	1.14 (0.38, 3.59)	0.81	0.63 (0.09, 4.10)	0.63

* Adjusted for other variables in the table

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