Assessing Relationships Between Adverse Childhood Experiences and Viral Suppression Among Persons Living with HIV in Washington State

Rachel Sanders

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Committee:

Julia Dombrowski

Steven Erly

Anjum Hajat

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Abstract

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Rachel Sanders

Chair of the Supervisory Committee:

Julia Dombrowski

Department of Epidemiology

Background: Adverse childhood experiences (ACEs) have been linked to a variety of negative health outcomes in adulthood and have been recognized as a hurdle to participating in HIV care. However, few studies have examined the cumulative impact that different types of childhood trauma have on HIV care engagement and HIV outcomes. To address this gap, this analysis sought to characterize the relationship between various types of childhood trauma, including abuse and household dysfunction trauma, and viral suppression among persons living with HIV.

Methods: This cross-sectional study utilized surveillance data from the 2018-2019 Medical Monitoring Project (MMP) cycle in Washington State. We conducted single-variable and multi-variable logistic regression analyses to quantify the impact that number of ACEs and the type of ACEs experienced has on viral suppression. We also used Poisson regression analyses to assess the relationship between ACEs and health related quality of life (HRQOL) among persons living with HIV.

Results: Among 328 participants, 86.8% of all individuals reported they had experienced at least 1 ACE and 39.5% reported they had experienced 4 or more. Adjusting for demographic characteristics, we did not find evidence of significant differences in odds of achieving cross-sectional viral suppression among individuals who had experienced 1, 2, 3, or 4+ ACEs, as compared to individuals who did not experience any ACEs (1: Adjusted OR= 0.65, 95% CI= 0.13, 3.25 | 2: Adjusted OR= 1.49, 95% CI= 0.20, 10.89 | 3:

Adjusted OR= 0.14, 95% CI= 0.03, 0.69 | 4+: Adjusted OR= 0.49, 95% CI= 0.12, 2.09). A higher number of ACEs was significantly associated with poorer self-reported HRQOL (1: Adjusted RR= 1.53, 95% CI= 0.69, 3.38 | 2: Adjusted RR= 2.87, 95% CI= 1.35, 6.09 | 3: Adjusted RR= 2.85, 95% CI= 1.35, 6.02 | 4+: Adjusted RR= 3.19, 95% CI= 1.59, 6.40).

Conclusion: We found that the prevalence of adverse childhood experiences was high among our study population. We did not find significant evidence of associations between adverse childhood experiences and viral suppression. However, we did find that a higher number of self-reported ACEs was significantly associated with poorer HRQOL. These results are important considerations in establishing trauma-informed systems for improving quality of life, health outcomes, and care engagement among persons living with HIV.

Introduction

Vast improvements in HIV outcomes have been made since the introduction of highly active antiretroviral therapy (ART) in the 1990s.[1] Proper ART use and adherence decreases replication of HIV in the body, leading to undetectable viral loads and a decreased risk in transmission of the virus over time.[2] Through this mechanism, ART has shown to increase life expectancy and health outcomes among persons living with HIV (PLWH).[3-4] However, while HIV outcomes can be greatly improved through medication use and adherence, there are many psychosocial factors that make HIV care engagement difficult. Mental health disorders and traumatic experiences are highly prevalent among PLWH.[5] Prior research has shown that depression, trauma, and post-traumatic stress disorder (PTSD) have been linked to poor physical and behavioral health outcomes among individuals living with HIV. These outcomes include poor ART adherence, diminished mental health-related quality of life (HRQOL), increased odds of engaging in risky transmission behaviors, increases in viral load and disease progression, and a higher risk of hospitalization and mortality.[5-10]

While the negative health and behavioral impacts of mental disorders and lifetime trauma have been extensively summarized in the literature, fewer studies have examined the impact that childhood trauma has on HIV outcomes later in life. Adverse childhood experiences (ACEs) can have serious consequences on health outcomes in adulthood and have been strongly linked to high-risk health behaviors, including smoking and drug use, as well as to chronic conditions such as cancer, heart disease, stroke, obesity, and diabetes.[11-12]

Studies have estimated that over 50% of persons living with HIV have a history of physical and sexual abuse during childhood.[6,13] ACEs have been shown to have harmful impacts on HIV-related risk behaviors. Physical abuse and sexual abuse during childhood have been linked to increased risk of HIV-transmission behavior in adulthood, including sexual compulsivity, substance abuse, and sex without barrier protection, especially among women.[14-15] Studies have also shown that HIV-infected women who have histories of childhood trauma may also be at a greater risk for poorer quality of life and impairments in daily living.[16] Childhood sexual abuse has also been associated with increased risk of medication nonadherence, which can increase viral load and disease progression.[7]

Adverse childhood experiences have also been linked to a variety of social factors that can limit engagement with healthcare services. Studies have found that individuals with a history of ACEs are more likely to have perceived financial barriers that prevent them from seeking health services in adulthood.[17-18] Adults who have experienced a high number of childhood adversities are also more likely to be unemployed, to experience job loss, to live in poverty, and to become reliant upon on public health coverage.[18-19] ACEs have also been linked to higher odds of being uninsured and receiving welfare benefits.[17,19] These socioeconomic factors can serve as barriers for regularly engaging in routine HIV care and treatment.[20]

While childhood trauma has been recognized as a hurdle to participating in HIV care, to date there has not been a comprehensive examination of the different types of trauma and their cumulative effect on HIV care engagement and HIV outcomes. The links between adverse childhood experiences and viral suppression generally remain unexplored. This study sought to bridge this gap and expand on prior work by evaluating the relationship between self-reported ACEs and both cross-sectional and durable viral suppression. The two main goals of the study were to assess the cumulative risk multiple self-reported ACEs have on cross-sectional and durable viral suppression status and to evaluate any differences in odds of achieving viral suppression based on the type of ACEs experienced: physical abuse, sexual abuse, emotional abuse, and adversities related to household dysfunction (i.e. having an incarcerated family member, parental separation/divorce).

As a secondary aim, this study also assessed the relationship between ACEs and health-related quality of life (HRQOL) among PLWH, as measured by self-reported number of unhealthy days in a 30-day period. With advances in HIV testing and antiretroviral medications, the survivability of HIV has greatly increased.[3] With better life expectancy among PLWH, quality of life has become a new and important focus among researchers who study HIV care.[21] HRQOL was recently introduced as a development indicator of HIV care in the 2022-2025 National HIV/AIDS Strategy for the United States.[22] Characterizing overall quality of life, and the factors that influence quality of life, is important in assessing the experiences, long-term HIV outcomes, and other health disparities among populations of persons living with HIV.

Methods

Data Source & Population

This cross-sectional study utilized data from the 2018-2019 Medical Monitoring Project (MMP) in Washington State. The MMP is a national behavioral and clinical surveillance system of adults diagnosed with HIV in the United States. The primary objective of the MMP is to provide representative estimates of HIV transmission risk behaviors and clinical outcomes at a national and state level and to understand the healthcare utilization patterns and needs of PLWH.[23] This information is captured via interview and through abstraction of medical record data. Medical record data related to viral load measures was obtained from Core HIV Surveillance.

In 2018, Washington implemented questions related to ACEs on their state-level questionnaire. This questionnaire asks 11 questions related to childhood trauma and collects information on the following eight ACE subcategories, as defined by the CDC: emotional abuse, physical abuse, sexual abuse (3 items), mental illness in the household, substance abuse in the household (2 items), adult violence in the household, incarcerated household member, and parental separation/divorce. These questions originated from the ACE module implemented in the Behavioral Risk Factor Surveillance System in 2009.[24] Washington's local questionnaire does not obtain any information related to the physical or emotional neglect categories.

This analysis included all persons who participated in the 2018-2019 Medical Monitoring Project. These individuals were all 18 years of age or older, had been diagnosed with HIV by a physician, and were residents of Washington at the time of interview. Participants were included in analysis if they answered "yes," "no" or "never," "once," "more than once" to at least one of the 11 ACE related questions in the survey, depending on the question asked. Participants with missing data for all 11 ACE questions or who could not be linked to Washington surveillance data were excluded.

Measures

ACEs were the exposure of interest and were classified in two different ways for analysis. Firstly, to understand the cumulative impact of ACEs on viral suppression, we examined the number of self-reported ACEs experienced and categorized these as 0, 1, 2, 3, 4+. The decision to categorize number of

reported ACEs was done so in order to mirror the categorization seen in previous studies that have examined the relationship between ACEs and HIV outcomes.[11,25] Secondly, we examined the impacts of the different types of ACEs experienced and defined ACEs by individual subcategory. The categories were emotional abuse, physical abuse, sexual abuse, mental illness in the household, substance abuse in the household, adult violence in the household, incarcerated household member, and parental separation/divorce. Inclusion into each ACE type was based on participants' responses to the corresponding ACE question in Washington's local MMP questionnaire. **Table 1** provides an overview of the determination criteria for inclusion into each type of ACE subcategory.

The primary outcomes of interest were cross-sectional viral suppression and durable viral suppression. Cross-sectional viral suppression was dichotomized (yes/ no) and defined as having <200 copies of HIV/ mL of blood at *the most recent* HIV viral load within the 12 months prior to the date of interview. Durable viral suppression was also dichotomized (yes/no) and defined as having <200 copies of HIV/ mL of blood for *all* viral loads measured within the 12 months prior to the date of interview. Participants who did not have any available viral load measures within the 12 months prior to their interview date were categorized as not virally suppressed, under the assumption that these participants were not regularly engaging with HIV care.

Health-related quality of life (HRQOL) was also examined as a secondary outcome of interest. HRQOL was approximated by the number of unhealthy days participants reported experiencing within the past 30 days.[26] This information was calculated based on responses to the following questions: "Now thinking about your physical health, which includes physical illness or injury, for how many days during the past 30 days was your physical health not good?" and "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" Based on CDC's guidelines for estimating unhealthy days, responses to these two questions were combined to calculate a summary index of overall unhealthy days, with a minimum of 0 unhealthy days and a logical maximum of 30 unhealthy days.[27]

There were several covariates that were included in analyses as confounders of interest. Demographic characteristics of interest were age (18-34, 35-54, ≥55), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic or Latino, other race or multiracial), gender (cisgender male, cisgender or

transgender female), sexual orientation (gay/lesbian, straight, bisexual/ other), household income (<$20,000, $20,000-$39,999, $40,000 - $74,999, ≥$75,000), education level (≤ high school diploma, >high school), and insurance status (private insurance, public insurance/ Ryan White HIV/AIDS Program or AIDS Drug Assistance Program only). Over 10% of the study population was represented within each covariate category to ensure the robustness of our multivariate regression models, due to our limited sample size.

Statistical Analysis

We first conducted descriptive analyses, assessing the prevalence of ACEs overall, and by demographic subgroups. We then developed logistic regression models to conduct single-variable analyses of the dose-response relationship between number of reported ACEs and cross-sectional viral suppression and durable viral suppression, respectively, as well as to assess the relationship between type of ACE experienced and viral suppression status. We then conducted multiple variable analyses, adjusting for confounding by age, race and ethnicity, gender, sexual orientation, household income, education level, and insurance status. These variables were included as adjusted covariates due to the documented existence of disparities in prevalence of ACEs, HIV care engagement, and viral suppression status by these demographic factors.[28-32] In the context of this analysis, we conceptualized race and ethnicity as a marker of the complex socioeconomic factors and life events experienced by different racial and ethnic groups that directly impact the likelihood of viral suppression. We also conducted a multivariate analysis that included all eight categories of ACEs in the same model. We calculated odds ratios (OR) and their associated 95% confidence intervals for all logistic regression models.

To address our secondary aim, we developed Poisson models to estimate risk ratios to quantify the relationship between ACEs and HRQOL. We conducted both single and multiple variable analyses, adjusting for the confounders above, to assess any differences between subcategories of ACEs experienced and the estimated average number of unhealthy days experienced, as well as any differences between number of ACEs and number of unhealthy days. To account for nonresponse and MMP's complex survey design, survey weights were incorporated into all analyses. All analyses were conducted using R version 4.0.2

Results

After excluding 23 individuals from our sample who did not answer any of the ACE questions and 13 individuals who did not have an associated HIV diagnosis date, we obtained a total of 328 individuals for analysis. The proportion of individuals in our sample with cross-sectional viral suppression was 87.8%, while 82.4% had achieved durable viral suppression. 86.8% of individuals in our sample reported they had experienced at least 1 ACE, and 39.5% reported they had experienced 4 or more. **Table 2** shows the distribution of total number of ACEs experienced broken down by demographic characteristics. The proportion of cisgender and transgender females who had experienced 4 or more ACEs was 20% higher than that of cisgender males (55.8% vs. 36.1%). Additionally, 64% of PLWH who had used injection drugs in the past 12 months had experienced 4 or more ACEs, compared to 38% of PLWH who did not report injection drug use in the past 12 months.

We found the prevalence for each of the eight categories of ACEs to be greater than 33%, with the exception of having an incarcerated household member, which was 10.5% There were differences in types of ACEs experienced by certain subpopulations, as can be seen in **Table 3**. The proportion of individuals who had experienced physical abuse and emotional abuse was lower among individuals aged 18-34, compared to individuals aged 55 or older (physical abuse 25.6.% vs 40.0%, emotional abuse 36.1% vs 60.0%). When comparing individuals who had used injection drugs in the past 12 months to those who had not, we found that the absolute difference in prevalence of ACEs experienced was higher by 10% or more across all subcategories, with the exception of parental separation or divorce. Sexual abuse was prevalent among 51.7% of cisgender and transgender females, compared to only 30.8% of cisgender males. There were also notable differences by race and ethnicity, with 48% of Hispanic or Latinos and 58% of multiracial or other races reporting adult violence in the household, compared to only 29% of White, non-Hispanics and 25% Black, non-Hispanics. Hispanic or Latinos and multiracial or other races also reported a higher percentage of physical abuse, sexual abuse, and having an incarcerated family member, compared to White non-Hispanics and Black non-Hispanics.

Table 4 shows the relationship between number of ACEs and viral suppression. After adjusting for age, race, gender, sexual orientation, income, education, and insurance status, we did not find clear evidence of significant differences in odds of achieving cross-sectional viral suppression among

individuals who had experienced 1, 2, 3, or 4+ ACEs, as compared to individuals who did not experience any ACEs (1: Adjusted OR= 0.65, 95% CI= 0.13, 3.25 | 2: Adjusted OR= 1.49, 95% CI= 0.20, 10.89 | 3: Adjusted OR= 0.14, 95% CI= 0.03, 0.69 | 4+: Adjusted OR= 0.49, 95% CI= 0.12, 2.09). When examining the relationship with durable viral suppression, we obtained similar findings. We did not find a distinct pattern of significant associations between odds of durable viral suppression and number of ACEs (1: Adjusted OR= 0.48, 95% CI: 0.13, 1.78 | 2: Adjusted OR= 0.82, 95% CI: 0.18, 3.61 | 3: Adjusted OR= 0.22, 95% CI= 0.06, 0.87 | 4+: Adjusted OR= 0.76, 95% CI= 0.23, 2.52).

Associations between the types of ACEs and viral suppression can also be seen in **Table 4**. In the adjusted analyses, we did not find any significant associations between odds of cross-sectional viral suppression across all eight ACE category types, when comparing PLWH who had experienced that type of ACE to those who had not. When examining durable viral suppression, we obtained identical findings. There was no clear association between durable viral suppression and any of the eight ACE categories we examined. **Table 5** summarizes the odds of cross-sectional and durable viral suppression for each category of ACE, after adjusting for the effects of all other categories. Similar to above, these results were not significant, with the exception of odds of durable viral suppression when examining emotional abuse (OR= 0.34, 95% CI= 0.14, 0.80).

In analyses of HRQOL, we found that the mean number of unhealthy days experienced in our population was 8.90 and the median was 3 days. The range of self-reported unhealthy days was from 0-30, and the interquartile range was from 0-15 days. We observed a dose-response relationship between number of ACEs and number of unhealthy days. We found that experiencing 2, 3, or 4+ ACEs was significantly associated with a higher number of average unhealthy days, as compared to individuals who experienced 0 ACEs (1: Adjusted RR= 1.53, 95% CI= 0.69, 3.38 | 2: Adjusted RR= 2.87, 95% CI= 1.35, 6.09 | 3: Adjusted RR= 2.85, 95% CI= 1.35, 6.02 | 4+: Adjusted RR= 3.19, 95% CI= 1.59, 6.40). We also found significant associations when examining HRQOL across the eight different types of ACEs, as can be seen in **Table 6**. We estimated a higher number of average unhealthy days for seven out of eight ACE subcategories, as compared to individuals who had not experienced each respective category of ACE. However, we did not find a significant association in estimated unhealthy days for individuals who had experienced parental separation/ divorce (Adjusted RR= 0.98, 95% CI= 0.73, 1.31).

Discussion

The purpose of this study was to characterize the relationship between childhood trauma and viral suppression status among persons living with HIV. We found that ACEs were highly prevalent among our sample of PLWH. However, we did not find evidence of a clear statistical relationship between viral suppression and either number or types of ACEs. On the contrary, we did obtain significant evidence of an association between ACEs and HRQOL, as measured by self-reported number of poor mental and physical health days in a 30-day period.

Over 75% of participants in our sample had experienced at least 1 ACE, while approximately one third of all participants had experienced 4 or more. These estimates are notably higher than the prevalence of adults in the United States who have experienced 1 or more ACE, which is estimated to be 61%.[33] These findings are consistent with other studies that have documented a higher number of ACEs among PLWH, compared to the population of the United States.[34] Additionally, we saw differences in prevalence of physical abuse, emotional abuse, sexual abuse, and adult violence in the household by age, gender, injection drug use, and race/ethnicity. These findings corroborate prior research that has documented a higher prevalence of ACEs among females, especially physical and sexual abuse.[14,35] It also supports prior work that has shown significant associations between a high ACE score and older age and with being an ethnic minority.[36] Disparities in ACE prevalence across demographic characteristics may reflect a relationship between ACEs and HIV risk behaviors, which can have implications for many health outcomes and HRQOL. These findings are important to consider when developing trauma-informed systems for HIV care, and approaches may need to be tailored to the varying trauma experiences of different subpopulations in order to improve HIV outcomes.

When examining the relationship between ACEs and viral suppression status, we did not obtain evidence of association in all crude and adjusted analyses, with the exception of one analysis that compared odds of viral suppression of persons with 3 ACEs to persons with 0 ACEs. These findings suggest that there is no direct association between number or type of ACEs and both cross-sectional and durable viral suppression among PLWH. These results provide support to prior research that has examined the impact of ACEs and trauma on viral suppression status. A study by Kidman et al. also found that cumulative ACE scores were not significantly associated with viral suppression.[37] Cuca et al.

noted an insignificant relationship when examining both childhood and adult trauma on viral load measures.[38] The lack of evidence to suggest a relationship between trauma and viral suppression could be due to the strength and quality of current antiretroviral medications. With the development and use of such potent antiretrovirals for HIV, viral suppression may be more common among PLWH, despite difficulties in engaging with regular medication adherence and care.

While we obtained null findings regarding childhood adversities and viral suppression, we did find significant evidence of a relationship between number and type of ACEs and HRQOL. We found evidence that a higher number of reported ACEs was associated with lower health-related quality of life. These findings are consistent with what is present in the literature. Prior studies have found that number of ACEs are significantly associated with increased odds or poor HRQOL in adulthood, as measured by number of unhealthy days, and that both physical and mental quality of life scores are significantly lower among PLWH who report a greater cumulative number of ACEs.[34,39] In addition to these findings, we also found evidence of a relationship between childhood physical abuse, emotional abuse, sexual abuse, mental illness in the household, substance abuse in the household, adult violence in the household, and having an incarcerated family member and a greater number of estimated unhealthy days per month among PLWH. Fewer studies have examined the impact that different categories of ACEs have on HRQOL, in addition to the total number of ACEs. Our findings suggest that all types of adverse childhood adversities, with the exception of parental/separation divorce, are significantly related to the daily mental and physical well-being of individuals living with HIV in adulthood. These results can have important implications for developing interventions in HIV care settings that assess a wide variety of childhood traumas among patients. Future efforts to develop trauma-based interventions based on the relationship between ACEs and quality of life could have immense health impacts among PLWH.

There are several limitations to our study that merit discussion. First, our sample from MMP relies on laboratory-based surveillance data for recruitment, which may bias the sample towards those who are successfully engaged in HIV care. This could lead to an overrepresentation of viral suppression within the population of PLWH. Additionally, this could also present an underestimate of the number of people with severe childhood trauma, as prior research has demonstrated that ACEs are linked to many social factors, including lower income and lower odds of being insured, that can prevent engagement with HIV

care services.[17-20] Another limitation that may have influenced our study findings is the presence of recall and social desirability bias; information related to demographics, childhood trauma, and injection drug use on the MMP survey were all collected via self-report and may be imperfect measures. This could have resulted in the underrepresentation of ACEs in our study sample and distort the relationship between ACEs and viral suppression. Furthermore, mild ACEs, such as parental separation/divorce were some of the most prevalent types of ACEs within the study population. 45% of all participants reported growing up with separated or divorced parents. With such a high prevalence of a minor ACE, as compared to the prevalence of more severe ACEs, such as physical abuse and sexual abuse, parental separation/ divorce may attenuate the relationship we see with viral suppression. All of these factors create difficulties in obtaining valid and robust associations through our statistical analyses. Lastly, due to the cross-sectional nature of this study and the ability of viral load to fluctuate over time, we are unable to establish causality and long-term patterns between ACEs and viral suppression status among persons living with HIV.

However, despite the limitations above and despite the inability to establish longitudinal patterns, the findings from this study serve as important guidance for the development of trauma-informed strategies for HIV care engagement and to improve long-term health outcomes for PLWH. Prior studies on childhood trauma and health outcomes among PLWH have primarily focused on the effects of physical or sexual abuse, especially among women, rather than looking across all types of childhood trauma. This study actively addressed this gap by examining associations between eight categories of traumas and HIV-related outcomes, including emotional abuse and household dysfunction trauma, in addition to sexual and physical abuse. The results of this study demonstrate that while there may not be a direct link between childhood trauma and viral suppression, there are associations between quantity and types of childhood adversities on overall quality of life. Health related quality of life is an important indicator in assessing the experiences of PLWH across the United States. Further efforts to understand the impact that childhood adversities have on quality of life will be critical in supporting the goals of the National HIV/AIDS Strategy to prevent new HIV infections, end care disparities, and improve health outcomes for all persons living with HIV.

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Table 1: Criteria for categorization of self-reported Adverse Childhood Experiences by subcategory

ACE Type	**MMP question(s):**	**Inclusion Criteria:**
Emotional Abuse	How often did a parent or adult in your home ever swear at you, insult you, or put you down?	Participant answered “once” or “more than once”
Physical Abuse	Before age 18, how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.	Participant answered “once” or “more than once”
Sexual Abuse	How often did anyone at least 5 years older than you or an adult, ever touch **you** sexually? How often did anyone at least 5 years older than you or an adult, try to make you touch **them** sexually? How often did anyone at least 5 years older than you or an adult, force you to have sex?	Participant answered “once” or “more than once” to any of the 3 questions
Mental Illness in the Household	Did you live with anyone who was depressed, mentally ill, or suicidal?	Participant answered “yes”
Substance Abuse in the Household	Did you live with anyone who was a problem drinker or alcoholic? Did you live with anyone who used illegal street drugs or who abused prescription medications?	Participant answered “yes” to at least one of the two questions
Adult Violence in the Household	How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?	Participants answered “once” or “more than once”
Incarcerated Household Member	Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?	Participant answered “yes”
Parental Separation/ Divorce	Were your parents separated or divorced?	Participants answered “yes.” Individuals who responded that their parents were never married will be considered a “no.”

Table 2: Demographic Characteristics of adults with HIV overall and by number of Adverse Childhood Experiences, Washington Medical Monitoring Project 2018-2019 (N=328)

Weighted Percentage (%)						
	Overall	**Number of ACEs**				
		0	1	2	3	4+
Gender						
Cisgender Male	82.6 (n=275)	14.3	18.4	15.5	15.7	36.1
Cisgender/ Transgender Female	17.4 (n=53)	7.8	19.1	12.2	5.0	55.8
Sexual Orientation						
Gay/ Lesbian	58.0 (n=193)	13.2	17.8	16.2	15.6	37.2
Straight	28.3 (n=86)	12.6	23.9	13.2	9.4	40.9
Bisexual/ Other	13.7 (n=48)	14.6	8.2	13.3	16.3	47.6
Injection Drug Use in the past 12 months						
Yes	6.0 (n=21)	10.3	0.0	15.7	9.6	64.4
No	94.0 (n=307)	13.4	19.7	14.9	14.2	37.9
Race/Ethnicity						
White, non-Hispanic	57.3 (n=188)	10.9	16.0	18.5	14.9	39.7
Black, non-Hispanic	17.6 (n=53)	17.6	26.8	15.4	13.4	26.8
Hispanic or Latino	14.0 (n=48)	13.7	23.7	7.7	10.6	44.3
Other Race / Multiracial	11.1 (n=39)	17.5	11.4	4.9	13.7	52.6
Age (years)						
18-34	9.0 (n=33)	20.7	18.9	17.6	17.8	25.0
35-54	55.6 (n=179)	12.7	21.1	13.3	9.7	43.1
≥55	35.4 (n=116)	12.0	14.3	16.8	19.4	37.6
Annual Household Income						
<$20,000	46.1 (n=150)	13.6	10.7	13.8	13.5	48.4
$20,000-39,999	17.0 (n=54)	14.3	32.8	12.7	15.8	24.4
$40,000 - $74,999	15.6 (n=51)	17.9	20.8	13.7	15.2	32.4
≥$75,000	21.2 (n=69)	8.6	23.1	19.6	11.8	36.9
Education Level						
≤ High School diploma	28.9 (n=92)	9.4	21.3	17.1	15.7	36.4
> High School	71.1 (n=236)	14.7	17.3	14.0	13.1	40.8
Insurance Status						
Private Insurance	42.5 (n=139)	16.3	19.3	17.9	16.4	30.0
Public Insurance/ Ryan White HIV/AIDS Program or AIDS Drug Assistance Program *only*	57.5 (n=185)	11.1	17.3	13.0	12.3	46.3
Total Population		13.2 (n=43)	18.5 (n=62)	14.9 (n=47)	13.9 (n=46)	39.5 (n=130)

Table 3: Demographic Characteristics of adults with HIV overall and by category of Adverse Childhood Experiences, WA MMP 2018-2019 (N=328)

Weighted Percentage (%)									
	Overall	Abuse			Household Challenges				
		Physical Abuse	Emotional Abuse	Sexual Abuse	Mental Illness in Household	Substance Abuse in Household	Adult Violence in Household	Incarcerated Family Member	Parental Separation or Divorce
Gender									
Cisgender Male	82.6 (n=275)	39.4	53.7	30.8	33.7	37.2	32.1	11.4	45.4
Cisgender/ Transgender Female	17.4 (n=51)	33.3	53.6	51.7	51.7	46.6	46.2	6.4	45.0
Sexual Orientation									
Gay/ Lesbian	58.0 (n=193)	42.4	58.1	30.0	33.1	37.4	34.2	11.6	44.2
Straight	28.3 (n=86)	28.7	47.7	37.7	41.8	37.5	33.9	11.8	48.1
Bisexual/ Other	13.7 (n=48)	41.7	48.7	47.1	42.6	48.7	37.5	3.7	43.2
Injection Drug Use in the past 12 months									
Yes	6.0 (n=21)	53.1	63.4	64.3	49.8	55.1	47.5	27.1	34.6
No	94.0 (n=307)	37.4	53.1	32.5	35.9	37.8	33.6	9.4	46.1
Race/Ethnicity									
White, non-Hispanic	57.3 (n=188)	38.8	57.7	32.0	37.4	42.0	29.3	9.9	50.3
Black, non-Hispanic	17.6 (n=53)	24.1	38.7	31.0	31.3	27.2	24.9	8.4	44.1
Hispanic or Latino	14.0 (n=48)	41.7	48.3	46.7	37.1	34.4	48.1	13.8	37.9
Other Race/ Multiracial	11.1 (n=39)	53.8	63.5	37.0	42.0	46.5	58.4	13.2	31.2
Age (years)									
18-34	9.0 (n=33)	25.6	36.1	29.3	40.5	31.2	26.0	24.0	31.5
35-54	55.6 (n=179)	39.3	52.5	35.1	37.5	41.4	35.6	10.9	44.0
≥55	35.4 (n=116)	40.0	60.0	34.7	34.8	36.9	34.7	6.4	51.1

Annual Household Income									
<$20,000	46.1 (n=150)	45.3	60.3	37.7	42.5	46.9	37.4	16.8	39.3
$20,000-39,999	17.0 (n=54)	24.1	41.3	27.6	25.4	23.9	20.0	3.2	56.4
$40,000 - $74,999	15.6 (n=51)	37.8	48.7	30.7	30.2	31.8	35.2	5.4	46.0
≥$75,000	21.2 (n=69)	35.6	52.6	36.0	36.3	36.7	36.6	5.5	50.9
Education Level									
≤ High School diploma	28.9 (n=92)	37.9	48.1	34.3	36.3	42.1	40.8	14.1	38.3
> High School	71.1 (n=236)	38.5	56.0	34.5	37.0	37.5	32.0	9.1	48.2
Insurance Status									
Private Insurance	42.5 (n=139)	32.9	51.3	31.7	31.3	29.8	30.1	5.4	48.2
Public Insurance or Ryan White HIV/AIDS Program/ AIDS Drug Assistance Program *only*	57.5 (n=185)	43.1	55.5	36.0	40.4	45.3	37.4	14.0	43.2
Total Population		38.3 (n=128)	53.7 (n=176)	34.4 (n=111)	36.8 (n=118)	38.9 (n=130)	34.5 (n=111)	10.5 (n=35)	45.4 (n=146)

Table 4: Estimated Associations between self-reported Adverse Childhood Experiences and viral suppression within the past 12 months among adults with HIV, WA MMP, 2018-2019

	Cross-Sectional Viral Suppression[+]				Durable Viral Suppression[++]			
	Crude OR	(95% CI)	Adjusted OR[*]	(95% CI)	Crude OR	(95% CI)	Adjusted OR[*]	(95% CI)
Number of ACEs								
0	Reference	-	Reference	-	Reference	-	Reference	-
1	0.51	(0.11, 2.33)	0.65	(0.13, 3.25)	0.49	(0.15, 1.59)	0.48	(0.13, 1.78)
2	1.50	(0.24, 9.58)	1.49	(0.20, 10.89)	0.86	(0.24, 3.12)	0.82	(0.18, 3.61)
3	0.21**	(0.05, 0.84)	0.14**	(0.03, 0.69)	0.32	(0.10, 1.05)	0.22**	(0.06, 0.87)
4+	0.50	(0.13, 1.89)	0.49	(0.12, 2.09)	0.76	(0.26, 2.27)	0.76	(0.23, 2.52)
Type of ACEs								
Physical Abuse	0.91	(0.42, 1.96)	0.89	(0.40, 1.98)	1.15	(0.61, 2.20)	1.20	(0.61, 2.34)
Emotional Abuse	0.63	(0.28, 1.43)	0.49	(0.20, 1.18)	0.64	(0.33, 1.24)	0.53	(0.25, 1.11)
Sexual Abuse	1.16	(0.49, 2.74)	1.09	(0.44, 2.71)	1.43	(0.69, 2.94)	1.33	(0.62, 2.84)
Mental Illness in Household	0.88	(0.39, 1.98)	0.87	(0.41, 1.88)	1.24	(0.62, 2.49)	1.33	(0.68, 2.63)
Substance Abuse in Household	0.64	(0.29, 1.40)	0.57	(0.25, 1.29)	0.89	(0.46, 1.70)	0.89	(0.45, 1.76)
Adult Violence in Household	0.91	(0.41, 2.02)	0.86	(0.38, 1.92)	1.07	(0.55, 2.09)	0.89	(0.47, 1.90)
Incarcerated Family Member	0.47	(0.17, 1.30)	0.49	(0.17, 1.38)	0.56	(0.23, 1.37)	0.72	(0.29, 1.75)
Parental Separation or Divorce	1.20	(0.55, 2.64)	1.16	(0.50, 2.67)	1.38	(0.72, 2.66)	1.30	(0.65, 2.61)

+ Cross-sectional viral suppression is defined as having <200 copies of HIV/ mL of blood at the *most recent* HIV viral load within the 12-month period prior to interview date

++ Durable viral suppression is defined as having <200 copies of HIV/ mL of blood for *all* viral loads measured within the 12-month period prior to interview date

* Adjusted models are adjusted for age, race, gender, sexual orientation, income, education, and insurance status

** Statistically significant at $\alpha = 0.05$

Table 5: Associations between type of ACE experienced and viral suppression status, adjusted for all other types of Adverse Childhood Experiences*

	Cross-Sectional Viral Suppression		Durable Viral Suppression	
	OR	(95% CI)	OR	(95% CI)
Type of ACEs				
Physical Abuse	1.23	(0.45, 3.37)	1.64	(0.69, 3.89)
Emotional Abuse	0.50	(0.19, 1.35)	0.34**	(0.14, 0.80)
Sexual Abuse	1.55	(0.63, 3.81)	1.77	(0.84, 3.76)
Mental Illness in Household	1.29	(0.54, 3.09)	1.71	(0.74, 3.93)
Substance Abuse in Household	0.72	(0.29, 1.81)	1.00	(0.46, 2.21)
Adult Violence in Household	1.03	(0.37, 2.86)	1.03	(0.42, 2.50)
Incarcerated Family Member	0.42	(0.14, 1.27)	0.39	(0.14, 1.08)
Parental Separation or Divorce	1.06	(0.49, 2.27)	1.36	(0.70, 2.65)

*All eight categories of ACEs were included as covariates in the same model. Age, race, gender, sexual orientation, income, education, and insurance status were not adjusted for in this model.
** Statistically significant at $\alpha = 0.05$

Table 6: Poisson regression analysis between self-reported ACEs and self-reported health-related quality of life measures among adults with HIV

Health-Related Quality of Life (Number of unhealthy days in 30-day period)+				
	Univariate Model		Adjusted Model++	
	Crude Relative Risk	95% CI	Adjusted Relative Risk	95% CI
Number of ACEs				
0	Reference	-	Reference	-
1	1.41	(0.64, 3.12)	1.53	(0.69, 3.38)
2	2.80**	(1.31, 6.00)	2.87**	(1.35, 6.09)
3	2.82**	(1.31, 6.08)	2.85**	(1.35, 6.02)
4+	3.37***	(1.66, 6.83)	3.19**	(1.59, 6.40)
Type of ACEs				
Physical Abuse	1.46**	(1.10, 1.93)	1.41*	(1.06, 1.87)
Emotional Abuse	1.65**	(1.21, 2.24)	1.54**	(1.13, 2.10)
Sexual Abuse	1.57**	(1.18, 2.08)	1.58**	(1.20, 2.08)
Mental Illness in Household	1.79***	(1.36, 2.36)	1.64***	(1.25, 2.15)
Substance Abuse in Household	1.83***	(1.39, 2.42)	1.64***	(1.23, 2.19)
Adult Violence in Household	1.46*	(1.10, 1.94)	1.47**	(1.10, 1.96)
Incarcerated Family Member	1.81***	(1.29, 2.54)	1.56*	(1.08, 2.25)
Parental Separation or Divorce	0.87	(0.65, 1.16)	0.98	(0.73, 1.31)

+Health-Related Quality of Life is a calculated index measured by the number of self-reported poor physical and/or mental health days within a 30-day period.
++ Adjusted for age, race, gender, sexual orientation, income, education, and insurance status
*p<0.05, **p<0.01, ***p<0.001