Evaluation of depressive symptoms, HIV vulnerability, and oral PrEP uptake and adherence among adolescent girls and young women in Western Kenya: a cross-sectional study

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Abstract

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Introduction

The mental health and well-being of individuals vulnerable to HIV acquisition are essential to achieving the maximum benefits of HIV prevention services including oral pre-exposure prophylaxis (PrEP). Yet, very little attention has been given to the role of mental health in HIV preventive interventions, especially among adolescent girls and young women (AGYW) in sub-Saharan Africa. We evaluated the relationship between depressive symptoms, HIV vulnerability, and oral PrEP uptake and adherence among Kenyan AGYW).

Methods

We conducted a cross-sectional study among AGYW participating in the Kenya Single-dose HPV vaccine-Efficacy (KEN SHE) Study, an ongoing randomized double-blinded prospective trial. We enrolled HIV-negative AGYW who attended follow-up visits in Kisumu between November 2023 and February 2024, excluding those who were within 42 days postpartum, older than 24 years and known to have or be undergoing treatment for a mental health disorder. Study staff administered questionnaires on demographics, depressive symptoms (using the PHQ-9), and HIV vulnerability. Data on oral PrEP were

extracted from the parent study database. We used descriptive statistics and multivariable logistic regression to explore associations with moderate to severe depressive symptoms (PHQ-9 ≥10). We evaluated the associations of moderate to severe depressive symptoms with HIV vulnerability factors and oral PrEP uptake and adherence.

Results

We enrolled 300 AGYW with a median age of 21 years (range 19-24). Overall 78% had at least high school education and 67% reported having been ever pregnant. The prevalence of moderate to severe depressive symptoms was 14.3% (95% confidence interval [CI] 10.5%-18.8%). AGYW who perceived their HIV risk as medium had increased odds (aOR= 3.23, 95%CI 1.29-8.25) of experiencing moderate to severe depressive symptoms, compared to those who reported not knowing about their risk. Additionally, AGYW who engaged in transactional sex (aOR 3.82, 95% CI 1.06-13.00), had a history of pregnancy (aOR 2.81, 95% CI 1.20-7.00), and had completed post-primary education (aOR 3.43, 95% CI 1.13-13.00) had increased odds of having moderate to severe depressive symptoms. Oral PrEP uptake was low at 19.3% (n=58, 95%CI 15.0%-24.0%). Among those taking PrEP, 43.0% reported taking at least 5 doses in the past week (n=25, 95%CI, 30.1%-56.7%). The presence of moderate to severe depressive symptoms did not predict oral PrEP uptake (OR= 1.12 95%CI 0.48-2.41), including after adjustment for potential confounders (aOR =1.01 95%CI 0.39-2.41). While the prevalence of moderate to severe depressive symptoms was lower in the group adherent to oral PrEP than in the non-adherent group this difference was not significant (8.0% vs 18.2%, p=0.44).

Conclusion

Our study findings demonstrate a relatively high prevalence (14%) of moderate to severe depressive symptoms among AGYW in western Kenya. AGYW who reported a medium risk of perception of HIV, those who had been pregnant once, those who engaged in transactional sex, and those who had completed post-primary education were more likely to report moderate to severe depressive symptoms, highlighting the need to integrate mental health assessment and support into HIV prevention services.

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Introduction

Globally, it is estimated that 4,000 adolescent girls and young women (AGYW) aged 15 to 24 contracted HIV each week in 2022. Most of these infections, approximately 3,100 cases per week, occurred in sub-Saharan Africa (SSA). SSA has the highest number of AGYW with an unmet need for HIV prevention (1), and accounted for 82% of all new HIV infections among adolescent girls and young women in 2022, with two-thirds of these occurring in eastern and southern Africa (2). The factors contributing to HIV acquisition among AGYW in SSA are multifaceted and complex, encompassing an array of biological, psychological, interpersonal, and structural elements (3–5). This convergence of factors has been described as creating a "unique vulnerability" among adolescents in this region (3,4). Oral pre-exposure prophylaxis (PrEP) is a highly efficacious HIV prevention strategy being scaled up for high-risk populations, including AGYW, in settings endemic to HIV. A single pill of oral PrEP, when taken daily by HIV-negative persons, reduces the risk of HIV transmission during sex by almost 99% (6). Oral PrEP allows AGYW to exercise greater control over HIV prevention and lowers the incidence of HIV infection (7).

Data from previous studies have identified several risk factors for HIV acquisition among AGYW in SSA, including poverty, transactional sex, inter-generational sexual relationships, and intimate partner violence (8,9). These risk factors are often linked to behaviors, such as condomless sex, which increase susceptibility to HIV infection (8). Additionally, sexually active individuals with mental health issues, notably depression, may face elevated risks due to behaviors including inconsistent condom use, multiple sexual partners, and alcohol consumption before sex (10–12). Factors driving depression among AGYW in SSA mirror those contributing to HIV risk behavior, such as poverty, socioeconomic disadvantage, and limited social support (13,14). Other risk factors related to depression among AGYW include exposure to violence, adolescent motherhood, and fear of HIV and other sexually transmitted infections (STI) (13,15,16). Depressive symptoms have been also associated with reluctance to undergo HIV testing, missed clinic appointments for HIV care, poor adherence to antiretroviral therapy (ART), and suboptimal viral suppression (17,18).

Despite there being an established relationship between the presence of moderate to severe depressive symptoms and risk of HIV acquisition there is a dearth of data examining this relationship among AGYW in SSA. A recent longitudinal study in South Africa and Zimbabwe demonstrated that persistent depressive symptoms are common among AGYW seeking PrEP initiation (19). While a metanalysis study showed that individuals with severe mental illness were at the highest risk of HIV acquisition and this relationship could be bidirectional (20), most studies included in this metanalysis were from high-income countries (21). It is crucial, therefore, to assess the relationship between moderate to severe depressive symptoms and high-risk HIV risk behavior and PrEP adherence among AGYW in SSA.

In Kenya, the prevalence of moderate to severe depressive symptoms ranges from 12%-47% among AGYW (22–24). In 2020, a third of all new HIV infections in Kenya occurred among AGYW (25), despite the rollout and availability of biomedical interventions such as oral PrEP. This paper consequently seeks to examine the prevalence of moderate to severe depressive symptoms, explore the association of HIV vulnerability (risk perception and sexual behaviors) factors with moderate to severe depressive symptoms, and test the association between moderate to severe depressive symptoms and both PrEP uptake and adherence among AGYW-aged between 18-24 years enrolled in a prospective randomized trial examining the efficacy of a single-dose HPV catch-up vaccine (26).

Methods

Study Design and Participants. These data were collected in a cross-sectional study of 300 adolescent girls and young women who were being followed in a prospective randomized controlled HPV vaccine study in Kenya (KEN SHE)(26) at its Kenya Medical Research Institute – Centre for Microbiology site in Kisumu, Western Kenya. The study was conducted at the Lumumba Sub-county Hospital and the Kargeno Research Hub, equipped with facilities and staff to conduct studies on sensitive subjects such as sexual and reproductive health and mental health among vulnerable groups such as adolescents. Kisumu County has one of the highest general population HIV prevalence rates in Kenya (18.6%) and also has the highest prevalence of oral PrEP use, at about 20% (27).

Inclusion and Exclusion Criteria. Individuals were eligible if they were enrolled in the KEN SHE study, between 18 and 24 years of age, HIV negative, and physically present at the site; spoke Dholuo, Swahili, and/or English; and were willing to provide informed consent. We excluded individuals who were within 42 days postpartum.

Study Procedures.

1. Screening

All KEN SHE participants who came to the clinic during the recruitment phase of this study (6th November 2023 through 31st January 2024) were briefed on the study and requested to consider participation if eligible. Potential participants were invited to a private room for screening using a screening checklist. Those found to be eligible were then offered informed consent. We recruited participants as they arrived for their KEN SHE visits until we met our sample target.

2. Informed consent

The trained research assistant discussed the consenting process with eligible participants. The consent forms were available in Dholuo, Swahili, and English, and participants selected their preferred language. All participants provided informed consent before taking part in this study.

3. Data collection procedures

The questionnaires were administered in face-to-face interviews by the research assistant using RedCap electronic data capture tools hosted at the University of Washington (28,29). The research assistants read the questions carefully to the participants and marked or recorded the participants' responses. For PHQ-9, the research assistant read all the questions to the participants initially and allowed the participants to think through the questions for up to two minutes. The research assistant then re-read the question while allowing

the participants to respond to each question. Participants were allowed to ask questions and seek clarification during the process.

4. Post-questionnaire review and counseling

Participants who had moderately severe to severe depressive symptoms (PHQ-9>15) or a score of 1 or more on item 9 (which asks about thoughts of suicide or self-harm) were referred for further evaluation and psychological support by a team led by a trained clinical psychologist.

5. Participant reimbursement

All participants were reimbursed Ksh 500 for their time spent participating in the study.

6. Extraction of data on oral PrEP uptake and adherence

Participants' data on PrEP use and adherence were extracted from relevant items in the KEN SHE study database, which were completed on the same day that data on sexual behavior and depressive symptoms were collected for this study.

Ethical statements. The study protocol was approved by the Kenya Medical Research Institute Scientific Ethics Review Unit, (KEMRI SERU), the University of Washington Human Subjects Division (UW HSD), and the National Commission for Science, Technology, and Innovation (NACOSTI.

Study Variables.

1. Socio-demographics

Socio-demographic data collected included age, highest level of education completed (none, primary, secondary, college, and university), marital status (single, married, divorced, widowed, and living with partner), parity (number of pregnancies, live births, number of living children), and individual source of income. For data analysis we dichotomized education variable “completed at most primary education” vs “post-primary education” and marital status into “single” vs “married” (married and living with partner).

2. HIV vulnerability

HIV vulnerability factors were evaluated using a standardized assessment tool created by the Kenya Ministry of Health to determine eligibility for oral PrEP. This tool assesses the following over the past one month: number of sexual partners, age of sexual partners, awareness of partners' HIV status, having sex without a condom, recent use of PEP, recent diagnosis or symptoms of STI, use of HIV post-exposure prophylaxis (PEP), involvement in transactional sex, and experiences of intimate partner violence. To

assess self-perceived risk for HIV acquisition, we asked participants *" Right now, would you say your risk of getting HIV is?"* the possible responses were low, medium, high, or don't know/unsure.

3. Depressive symptoms

The validated Patient Health Questionaire-9 (PHQ-9) adolescent version was used to assess individuals' depressive symptoms over the last 2 weeks (30). Each of the nine questions received a score from "0" (not at all) to "3 (nearly every day). A composite score of 0–27 was calculated, and a score of ≥10 was regarded as having moderate to severe depressive symptoms.

4. Oral PrEP use data

Data on oral PrEP uptake and adherence were extracted from the KEN SHE study database, including self-reported use of oral PrEP since the last scheduled visit (whether or not oral PrEP refill or initiation was done on-site) and the number of days on which the participant missed taking oral PrEP in the preceding week. PrEP uptake was defined as the use of oral PrEP since the last scheduled visit, while adherence was defined as taking oral PrEP on at least five of the preceding seven days.

Data analysis. Descriptive statistics were employed to summarize the data, including frequency and percentages for categorical variables and mean and standard deviation for continuous variables. The Pearson Chi-square test or Fisher's exact test were used to evaluate differences between participants with and without moderate to severe depressive symptoms as defined above. Bivariable and multivariable logistic regression analyses were carried out to identify factors associated with the outcome variable (i.e., moderate to severe depressive symptoms or PrEP use). Unadjusted and adjusted odds ratios (aOR) were calculated with 95% confidence intervals (CI). The logistic regression model was explained by the following equation:

$$\text{Log}[p(Y) / (1-p(Y))] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots. + \beta_n X_n + e$$

where:

p(Y): Is the expected probability of the outcome variable to occur,

β_0 is the intercept/ constant

β_1 through β_n are the regression coefficients

X_1 through X_n are distinct independent variables, and

e is the error term

We used Fisher's Exact test to test the significance of the relationship of moderate to severe depressive symptoms with oral PrEP adherence, due to small cell counts. Due to the limited sample size, we did not do any regression analysis for this outcome.

The statistical software program R version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria, 2024) was used for data management and analysis. A p-value below 0.05 was considered statistically significant.

Results

Sociodemographic and sexual risk behavior outcomes. Participants' sociodemographic characteristics are described in detail in **Table 1** overall and by whether or not the participant had moderate to severe depressive symptoms. **Figure 1** presents a participant flow diagram depicting the number enrolled, the number taking oral PrEP, and the number adherent to PrEP who were included in each analysis. The mean age of participants was 21.0 years (SD 1.4 years), and most were single (n=230, 77%). Additionally, most participants had achieved at least a high school education (n = 234, 78%). A minority reported having a regular income (n = 89, 30%), and only a small proportion were students (n = 69, 23%). A significant portion of participants had ever been pregnant (n = 201, 67%). There were no differences in sociodemographic characteristics by depression status.

Regarding sexual behavior and HIV risk perception, very few participants reported being at high risk (n = 26, 8.7%), but many reported not knowing their risk (n=129, 43.0%) or having a medium risk (n=52, 17.3%). The majority reported having only one sexual partner (n=255, 85.0%) and most reported their partner's HIV status as negative (n=233, 78.0%). A significant proportion reported engaging in condomless sex during their last intercourse (n=186, 62.0%). Only a small number reported recent diagnosis or treatment of an STI (n=34, 11.3%) or intimate partner violence (n=35, 11.6%). HIV risk perception was the only HIV vulnerability characteristic that differed by depression status, with fewer participants who had moderate to severe depressive symptoms reporting low risk and more reporting medium risk. **Figure 2** shows the relationship between self-reported HIV risk perception and moderate to severe depressive symptoms.

Prevalence of depressive symptoms. The prevalence of moderate to severe depressive symptoms i.e., PHQ-9 ≥10 was 14.3% (95%CI 10.5%, 18.8%). **Table 2** presents the distribution of responses to the PHQ-9 questions. Approximately 16% of participants reported suicidal ideation or thoughts of self-harm. A majority (67%) reported being sad or depressed at some point over the past 12 months. **Figure 3** shows the prevalence of moderate to severe depressive symptoms based on participant age. Of note, the difference in depressive symptoms across ages was not statistically significant (p = 1.0).

Relationship between HIV vulnerability and moderate to severe depressive symptoms. **Table 3** presents results of bivariable and multivariable logistic regression analyses of the association between HIV vulnerability and the presence of moderate to severe depressive symptoms (PHQ≥10). In bivariable analysis, AGYW who perceived their HIV risk to be medium had an increased odds (OR 2.60, 95%CI 1.15-5.84) of having moderate to severe depressive symptoms relative to those who reported not knowing their risk. In multivariable analysis, AGYW who perceived their HIV risk to be medium still had an increased odds (aOR 3.23, 95%CI 1.29-8.25) of depression relative to those who reported not knowing their risk. In

addition, AGYW who reported engaging in transactional sex (aOR 3.82, 95% CI 1.06, 13.0), had been pregnant once (aOR, 2.81, 95%CI 1.20, 7.00), and those whose highest education qualifications were beyond primary education (aOR, 3.43, 95%CI 1.13,13.0) had increased odds of having moderate to severe depression. **Figure 4** presents a forest plot of the multivariable analysis estimates and their 95% CI for the relationship between HIV vulnerability and moderate to severe depressive symptoms.

Relationship between moderate to severe depressive symptoms and PrEP use and adherence. The prevalence of oral PrEP use was 19.3 % (n=58, 95%CI 15%, 24%) among participants who took part in this study. Among PrEP users, 43% (n=25, 95%CI, 30.1%. 56.7%) reported taking oral PrEP for at least five days in the previous seven days. **Figure 5** shows the proportion of participants who reported moderate to severe depressive symptoms based on their oral PrEP use status.

In bivariable logistic regression analysis of the factors associated with use of oral PrEP, AGYW who reported who perceived their risk of HIV acquisition to be high (OR 3.74, 95%CI 1.39,9.74), who reported having multiple sexual partners (OR 2.17, 95% CI 1.04, 4.35) and whose partners were living with HIV (OR 29.3, 95%CI 4.54-570) had increased odds of using oral PrEP. In multivariable logistic regression, the only variable associated with PrEP use was having an HIV-positive partner (aOR, 23.2, 95%CI 3.33-468) and those who were unsure of their partner's HIV status (aOR,2.47, 95%CI 1.57, 5.17). Detailed results are presented in **Table 4**. The proportion of AGYW who had moderate to severe depressive symptoms was more than two times higher among AGYW who were non-adherent than it was among AGYW who were adherent to PrEP (18.5% versus 8.0%), but this difference was not statistically significant (p = 0.44). **Figure 6** displays the prevalence of moderate to severe depressive symptoms among PrEP users by adherence status.

Discussion

In this cross-sectional study, we evaluated the prevalence of moderate to severe depressive symptoms, explored HIV vulnerability factors associated with moderate to severe depressive symptoms, and tested the association between moderate to severe depressive symptoms and both oral PrEP use and adherence among a cohort of AGYW enrolled in a prospective randomized controlled trial. The prevalence of moderate to severe depressive symptoms using the adolescent version of the PHQ-9 (30) was about 15% at a cut-off PHQ-9 score of ≥10. These findings are comparable with the findings from other recent studies in Kenya and SSA that assessed the prevalence of depression among AGYW attending antenatal care clinics or seeking reproductive services (23), enrolling in HIV prevention intervention clinical trials (31), and attending schools and college (22,32). About a fifth of AGYW who participated in this study reported using oral PrEP, comparable to the proportion of individuals who reported oral PrEP refills in the Jilinde HIV prevention program in Kenya (33). Similar reports of low oral PrEP uptake have been reported in other studies of reproductive health that introduced oral PrEP as part of comprehensive reproductive health care (34,35). Self-reported oral PrEP adherence, defined as taking PrEP on at least 5 of the previous 7 days, was only about 30%, consistent with previous studies that reported that most AGYW prefer taking AGYW on demand as opposed to daily pills (36,37).

We hypothesized that AGYW with moderate to severe depressive symptoms would be more likely to report engaging in high-risk HIV behaviors because the drivers of AGYW's mental health also influence their sexual behavior and their ability to seek HIV prevention services. In our analysis, self-reported medium HIV risk perception, having been pregnant once, engaging in transactional sex, and having more than primary education were positively associated with moderate to severe depressive symptoms. Prior studies have found that moderate to severe depressive symptoms among AGYW is associated with high HIV risk scores even after adjusting for age and prior pregnancy (23) using a validated HIV risk score among AGYW in Kenya (38), engaging in transactional sex, being forced to engage in sex, intimate partner violence (19,39,40), and alcohol and substance use (14,17). Our participants who had completed post-primary education were more likely to report moderate to severe depressive symptoms, which is comparable to findings from a recent study in Tanzania (41). This association between post-primary education completion and depression has been shown to be mediated through a lack of employment, low-quality employment, and income income-generating activities (41–43). Among AGYW, having high social support and financial empowerment have been associated with both lower rates of HIV vulnerability and depression (44,45).

Depression is common within the first year after delivery, related to the major physiological and psychological demands of pregnancy and the postpartum period (14,46). In our study we excluded

AGYW, who were within 42 days postpartum, still having been pregnant was positively associated with moderate to severe depressive symptoms. Adolescent pregnancy is framed as a social problem(47) as a result pregnant adolescents receive inadequate social support, disruption in their education, endure societal prejudice, and isolation, all of which profoundly affect their mental health regardless of the pregnancy outcomes(13,48,49). A prior study using KEN SHE study data showed that the rate of abortion among this cohort was as high as 24%(50), given that abortion services are not readily available in Kenya, the stress and hustle of getting abortion services could be contributing to the mental distress observed in among AGYWs who have ever been pregnant. These adverse mental health outcomes might persist throughout adolescent life (47). Other factors that contribute to depression among AGYW in SSA that we did not assess due to the design of our study are early sexual debut, food insecurity, rigid social norms, and under-resourced health systems (51–54). Our findings make a strong case for the incorporation of mental health screening and evidence-based psychosocial interventions in outpatient services targeting AGYW in SSA.

In our analysis, we did not find any significant association between the presence of moderate to severe depressive symptoms and oral PrEP uptake among AGYW, even after adjusting for other covariates. Moderate to severe depressive symptoms were more common among AGYW who were non-adherent to oral PrEP than those who were adherent (18.6% versus 8.0%). However, this difference was not significant, and we were very underpowered to test this association given the low PrEP oral uptake in this population. Several studies among AGYW at risk of HIV infection have demonstrated that moderate to severe depressive symptoms and other common mental health disorders such as anxiety, negatively influence oral PrEP uptake and oral PrEP adherence (19,20,55,56). Depression and other common mental health disorders are also linked to distorted HIV risk perception and sexual risk behavior (55), including condomless sex and multiple sexual partners (23,57) which could affect the AGYW behavior around PrEP use. While other studies have shown that depressed individuals are less likely to engage in sex and may stop taking oral PrEP as a result (20), our study was not designed to evaluate how participants were matching PrEP to their sexual activity, and participants who were not using or not taking PrEP (whether depressed or not), may have been acting appropriately.

Thoughts of self-harm or suicidal ideation were reported by about 16% of AGYW who participated in this study. This percentage is notably high, considering that our participants were AGYW who regularly interacted with healthcare settings for almost five years during their KEN SHE study visits. All participants who reported such thoughts were referred for psychosocial support. Anecdotally, in their engagement with the clinical psychologist on site, most of these participants reported no specific plan to harm themselves, but a small number reported having attempted suicide before while others were working

on a suicide plan. Contributing factors that came up in these discussions included economic hardship, lack of social support, abandonment by sexual partners during pregnancy, inability to provide for their children, dysfunctional family environments, parental conflicts, and financial constraints impeding their academic aspirations. These findings, which were not formally a part of this study, are similar to those reported in qualitative studies on factors associated with suicidal ideation among AGYW in Kenya (58,59). While Kenya has adopted the World Health Organization's recommendation to integrate mental health screening and care into sexual and reproductive health services, (60,61) this study highlights the high prevalence of moderate to severe depressive symptoms and of thoughts of suicide or self-harm among AGYW seeking HIV prevention services. We urge re-evaluation of oral PrEP service delivery models to guarantee that AGYW at risk for HIV have timely access to mental health services, including suicide prevention programming, regardless of whether they opt to use PrEP.

Our study's strength lies in the utilization of a validated PHQ-9 tool to assess depressive symptoms among AGYW. In addition, we were able to obtain complete data on all participants surveyed. Nevertheless, there were several limitations to this work. First, the cross-sectional design of our study limits us from establishing the temporal relationship and causal direction between depressive symptoms, HIV vulnerability, and oral PrEP uptake and adherence. Second, we relied on self-reported data from participants on their sexual behavior, oral PrEP uptake, and oral PrEP adherence, which may have introduced reporting bias and social desirability bias, to mitigate these the research assistant reassured the participants of the confidentiality of their data, and interviews were done with privacy. Third, the number of participants who reported using oral PrEP was much lower than we expected when designing the study, reducing power and increasing the risk of type II error, especially when assessing the relationship between moderate to severe depression and PrEP adherence. Additionally, we did not use pharmacokinetics data to evaluate biomarker-based PrEP adherence, which may have been even lower than that reported by our participants. Finally, our AGYW participants were enrolled in an ongoing randomized trial and therefore regularly engage with healthcare providers and research. This might limit the generalizability and transportability of our findings.

Conclusion

Our study findings demonstrate that the prevalence of moderate to severe depressive symptoms is relatively high among AGYW in Kenya, accompanied by the notable prevalence of thoughts of self-harm or suicidal ideation. AGYW who reported a medium risk of perception of HIV, those who had been pregnant once, those who engaged in transactional sex, and those who had completed post-primary education were more likely to report moderate to severe depressive symptoms, highlighting the need to integrate mental health assessment and support into HIV prevention services. As the mantra goes, "There is no health without mental health." We hope our findings will contribute to the growing body of evidence advocating for the urgent integration of mental health services into all primary health activities. No one must be left behind, prompting policymakers to allocate resources to enhance access to mental health services, particularly for underserved populations.

Table 1: Participant demographic and sexual risk behavior characteristics, overall and by depression category at the cutpoint of PHQ≥10, comparing those with moderate to severe depression to those with mild or no depression.

Demographic characteristics				
Variable	Overall N=300	PHQ<9 N=257	PHQ≥10 N=43	p-value[1]
Marital Status				0.13
Divorced	3 (1.0%)	1 (0.4%)	2 (4.7%)	
Married	66 (22%)	58 (23%)	8 (19%)	
Single	230 (77%)	197 (77%)	33 (77%)	
Widowed	1 (0.3%)	1 (0.4%)	0 (0%)	
Highest Education Level				0.40
Primary	49 (16%)	44 (17%)	5 (12%)	
High School	234 (78%)	197 (77%)	37 (86%)	
College	17 (5.7%)	16 (6.2%)	1 (2.3%)	
Has Own Income				0.50
No	211 (70%)	179 (70%)	32 (74%)	
Yes	89 (30%)	78 (30%)	11 (26%)	
Ever Pregnant				0.30
Never	99 (33%)	89 (35%)	10 (23%)	
Once	148 (49%)	123 (48%)	25 (58%)	
More than once	53 (18%)	45 (18%)	8 (19%)	
Sexual Risk Behavior				
HIV Risk Perception				**0.03**
Low	93 (31%)	81 (32%)	12 (28%)	
Medium	52 (17%)	38 (15%)	14 (33%)	
High	26 (8.7%)	25 (9.7%)	1 (2.3%)	
Don't Know	129 (43%)	113 (44%)	16 (37%)	
Multiple Sexual Partners				0.90
Only one sexual partner	255 (85%)	218 (85%)	37 (86%)	
More than one sexual partner	39 (13%)	34 (13%)	5 (12%)	
Not Sure	6 (2.0%)	5 (1.9%)	1 (2.3%)	
HIV Positive Partner				0.70
No	233 (78%)	201 (78%)	32 (74%)	
Yes	6 (2.0%)	5 (1.9%)	1 (2.3%)	
Not Sure	61 (20%)	51 (20%)	10 (23%)	
Sex Without Condom Last				0.90

No	113 (38%)	96 (37%)	17 (40%)	
Yes	186 (62%)	160 (62%)	26 (60%)	
Not Sure	1 (0.3%)	1 (0.4%)	0 (0%)	
Recent History Of STI Diagnosis or Treatment				0.20
No	251 (84%)	217 (84%)	34 (79%)	
Yes	34 (11%)	26 (10%)	8 (19%)	
Not Sure	15 (5.0%)	14 (5.4%)	1 (2.3%)	
Intimate Partner Violence				0.12
No	261 (87%)	227 (88%)	34 (79%)	
Yes	35 (12%)	26 (10%)	9 (21%)	
Not Sure	4 (1.3%)	4 (1.6%)	0 (0%)	
Transactional Sex				0.11
No	279 (93%)	242 (94%)	37 (86%)	
Yes	20 (6.7%)	14 (5.4%)	6 (14%)	
Not Sure	1 (0.3%)	1 (0.4%)	0 (0%)	
Using PrEP				0.80
No	242 (81%)	208 (81%)	34 (79%)	
Yes	58 (19%)	49 (19%)	9 (21%)	

[1] Fisher's exact test; Pearson's Chi-squared test

Table 2: Responses across PHQ-9 items

	Not at All (0)	**Several days (1)**	**More than half of the days (2)**	**Nearly every day (3)**
Feeling down, depressed or, irritable.	148 (49%)	84 (28%)	45 (15%)	23 (7.7%)
Little interest or pleasure in doing things?	159 (53%)	81 (27%)	37 (12%)	23 (7.7%)
Trouble falling asleep, staying asleep, or sleeping too much?	186 (62%)	62 (21%)	25 (8.3%)	27 (9.0%)
Poor appetite, weight loss, or overeating?	183 (61%)	67 (22%)	26 (8.7%)	24 (8.0%)
Feeling tired, or having little energy?	152 (51%)	89 (30%)	32 (11%)	27 (9.0%)
Feeling bad about yourself - or feeling that you are a failure, or that you have let yourself or your family down?	210 (70%)	51 (17%)	26 (8.7%)	13 (4.3%)
Trouble concentrating on things like schoolwork, reading, or watching TV?	223 (74%)	55 (18%)	14 (4.7%)	8 (2.7%)
Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you were moving around a lot more than usual?	244 (81%)	31 (10%)	13 (4.3%)	12 (4.0%)
Thoughts that you would be better off dead, or of hurting yourself in some way?	252 (84%)	32 (11%)	7 (2.3%)	9 (3.0%)

Table 3: Bivariable and multivariable logistic analysis of the association between HIV vulnerability and moderate to severe depressive symptoms

Variable	OR (95% CI)	p-value	aOR (95%CI)	p-value
Relationship status		0.56		0.61
Currently not in a relationship	Ref.		Ref.	
In a relationship	0.78 (0.32, 1.71)		0.73 (0.25, 1.94)	
Age categories		0.90		0.93
21 years and above	Ref.		Ref.	
Less than 21 years	1.03 (0.52, 1.97)		1.03 (0.48, 2.16)	
Highest Level of Education		0.35		**0.03**
Primary	Ref.		Ref.	
Post Primary	1.57(0.63, 4.75)		3.43(1.13,13.00)	
Individual income		0.53		0.21
Without a salaried job	Ref.		Ref.	
With a salaried job	0.79 (0.36, 1.60)		0.60 (0.25, 1.33)	
Ever Been Pregnant		0.30		**0.04**
Never	Ref.		Ref.	
Once	1.81 (0.85, 4.12)		2.81(1.20, 7.06)	
More than Once	1.58 (0.57, 4.29)		3.25(0.92, 11.6)	
HIV risk perception		**0.03**		**0.01**
Don't Know	Ref.		Ref.	
Low	1.05 (0.46, 2.32)		1.06(0.44, 2.52)	
Medium	2.6 (1.15, 5.84)		3.23 (1.29, 8.25)	
High	0.28 (0.02, 1.49)		0.23 (0.01, 1.33)	
Number of sexual partners		0.84		0.17
One or no sexual partner	Ref.		Ref.	
More than one sexual partner	0.91 (0.33, 2.15)		0.51 (0.15, 1.46)	
Condom use in last sex		0.79		0.30
No condom in last sex	Ref.		Ref.	
Condom used in last sex	0.91 (0.47, 1.79)		0.68 (0.32, 1.46)	
STI diagnosis or treatment		0.22		
No	Ref.		Ref.	0.19
Yes	1.96 (0.78, 4.54)		2.36 (0.84, 6.32)	
Not sure	0.46 (0.02, 2.38)		0.47 (0.02, 2.97)	
Transactional Sex		0.08		**0.04**
No	Ref.		Ref.	
Yes.	2.62(0.89, 6.89)		3.82(1.06, 13.0)	
Intimate Partner Violence		0.11		0.23
No	Ref		Ref.	

Yes	2(0.84, 4.45)		1.86(0.66, 4.88)	

aOR = adjusted odds ratio, CI = confidence interval, OR = odds ratio, STI = sexually transmitted infection

Table 4: Bivariable and multivariable logistic analysis of factors associated with oral pre-exposure prophylaxis uptake.

Variable	OR (95% CI)	p-value	aOR(95%CI)	p-value
Depressive symptoms		0.77		0.99
None or mild depressive symptoms	Ref.		Ref	
Moderate to severe depressive symptoms	1.12 (0.48, 2.41)		1.01(0.39, 2.41)	
Age categories		0.68		0.45
21 years and above	Ref.		Ref.	
Less than 21 years	1.13 (0.63, 2.02)		1.31(0.65, 2.60)	
Individual income		0.06		0.18
Without a salaried job	Ref.		Ref.	
With a salaried job	1.75(0.96, 3.17)		1.60(0.80-3.15)	
Partner's age		0.12		0.26
Less than 25 years	Ref		Ref.	
25 years and above	1.58 (0.88, 2.81)		1.46(0.75, 2.83)	
Highest Level of Education		0.17		0.39
Primary	Ref.		Ref.	
Post Primary	0.60 (0.30-1.27)		0.69(0.30,1.64)	
HIV risk perception		**<0.01**		0.13
Don't Know	Ref.		Ref.	
Low	1.58(0.75, 3.34)		1.85(0.81, 4.27)	
Medium	3.14(1.42, 6.96)		2.33(0.97, 5.58)	
High	3.74(1.39, 9.74)		2.78(0.94, 7.90)	
Ever Been Pregnant		0.35		0.75
Never	Ref.		Ref.	
Once	1.42 (0.73, 2.87)		1.34(0.62, 2.96)	
More than Once	1.82(0.78, 4.20)		1.36(0.46, 3.95)	
Multiple sexual partners		**0.04**		0.12
One or no sexual partner	Ref.		Ref.	
More than one sexual partner	2.17(1.04, 4.35)		1.94(0.84, 4.33)	
Condom use in last sex		0.80		0.49
Condom used in last sex	Ref.		Ref.	
The condom was not in last sex	1.08 (0.60, 1.98)		0.78(0.39, 1.58)	
Past month STI diagnosis or treatment		0.22		0.50
No	Ref.		Ref.	
Yes	1.96(0.84, 4.29)		1.71(0.67,4.18)	
Not Sure	1.71(0.46, 5.27)		1.31(0.28, 5.00)	
HIV Positive Partner		**<0.01**		**<0.01**
No	Ref.		Ref.	

Yes	29.3(4.54, 570)		22.60(3.00, 476)	
Not sure	2.65(1.36, 5.06)		2.47(1.57, 5.17)	
Transactional Sex		0.29		0.98
No	Ref.		Ref.	
Yes.	1.75(0.60, 4.52)		1.02(0.29, 3.21)	
Intimate Partner Violence		0.30		0.92
No	Ref.		Ref.	
Yes	1.53 (0.67, 3.26)		0.95(0.36, 2.36)	

aOR = adjusted odds ratio, CI = confidence interval, OR = odds ratio, STI = sexually transmitted infection

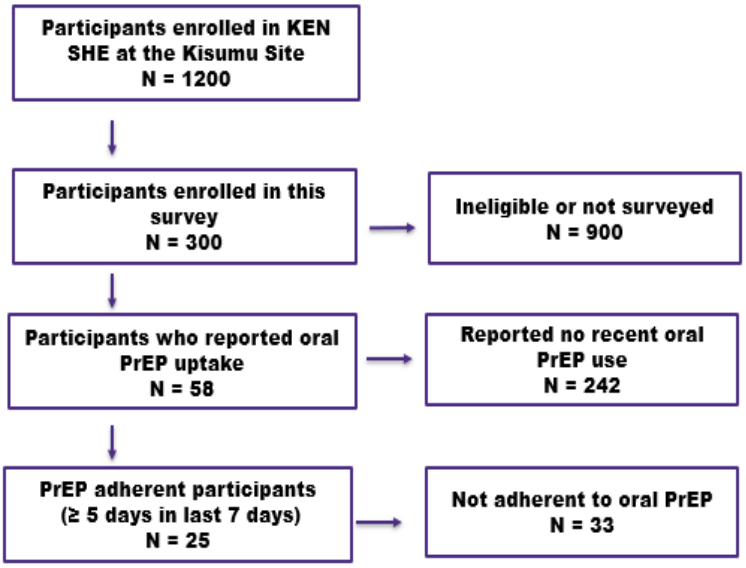

Figure 1: Participant flow diagram depicting the number enrolled, number taking oral PrEP, and number adherent to PrEP."

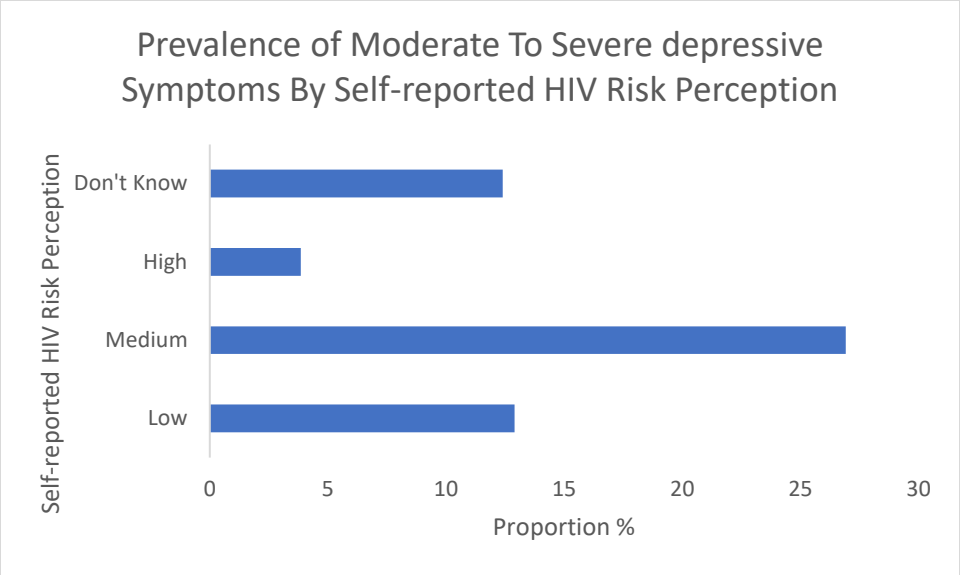

Figure 2: Prevalence of moderate to severe depressive symptoms among KEN SHE participants based on their self-reported HIV risk perception. Moderate to severe depressive symptoms were defined by a PHQ score of 10 or more.

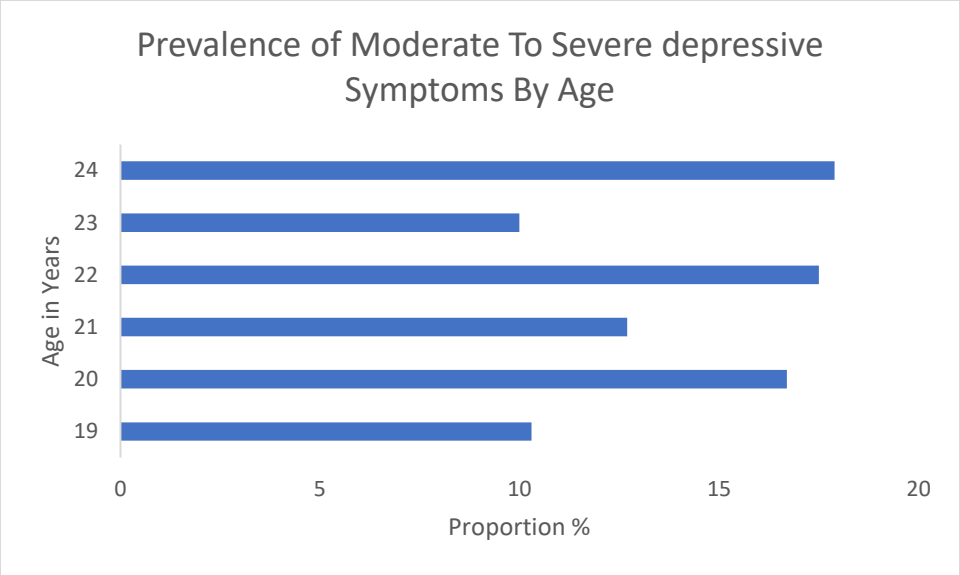

Figure 3: Prevalence of moderate to severe depressive symptoms among KEN SHE participants who took part in this study by age. Moderate to severe depressive symptoms were defined by a PHQ score of 10 or more.

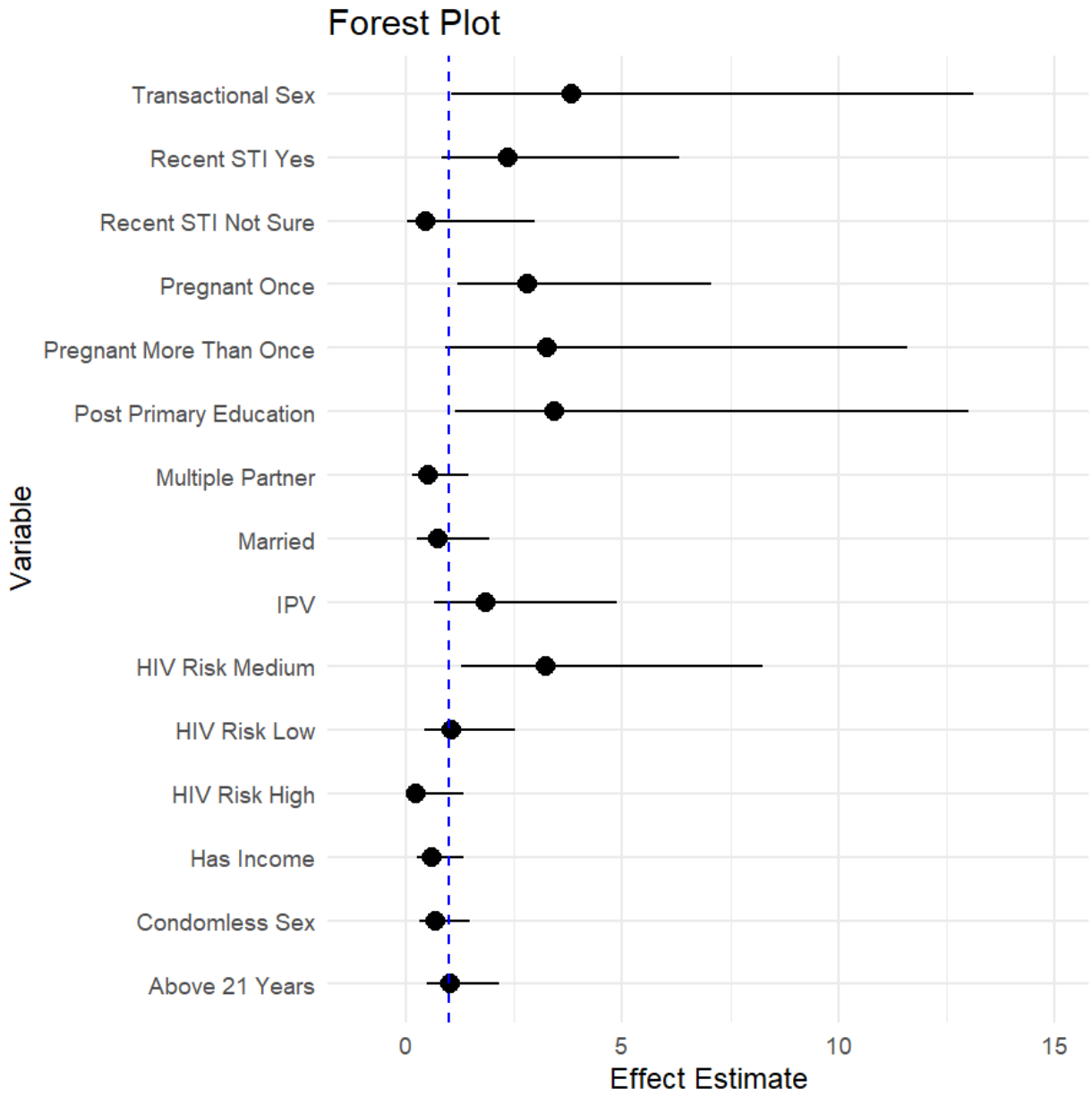

Figure 4: Forest plot for estimates of adjusted odds ratios and 95% CI for the exploratory multivariable analysis for the relationship between HIV vulnerability and moderate to severe depressive symptoms.

The reference group for pregnancy was "never been pregnant," for STI was "no recent STI diagnosis/treatment," and for HIV risk was "don't know."

Key: IPV = intimate partner violence, STI = sexually transmitted infection.

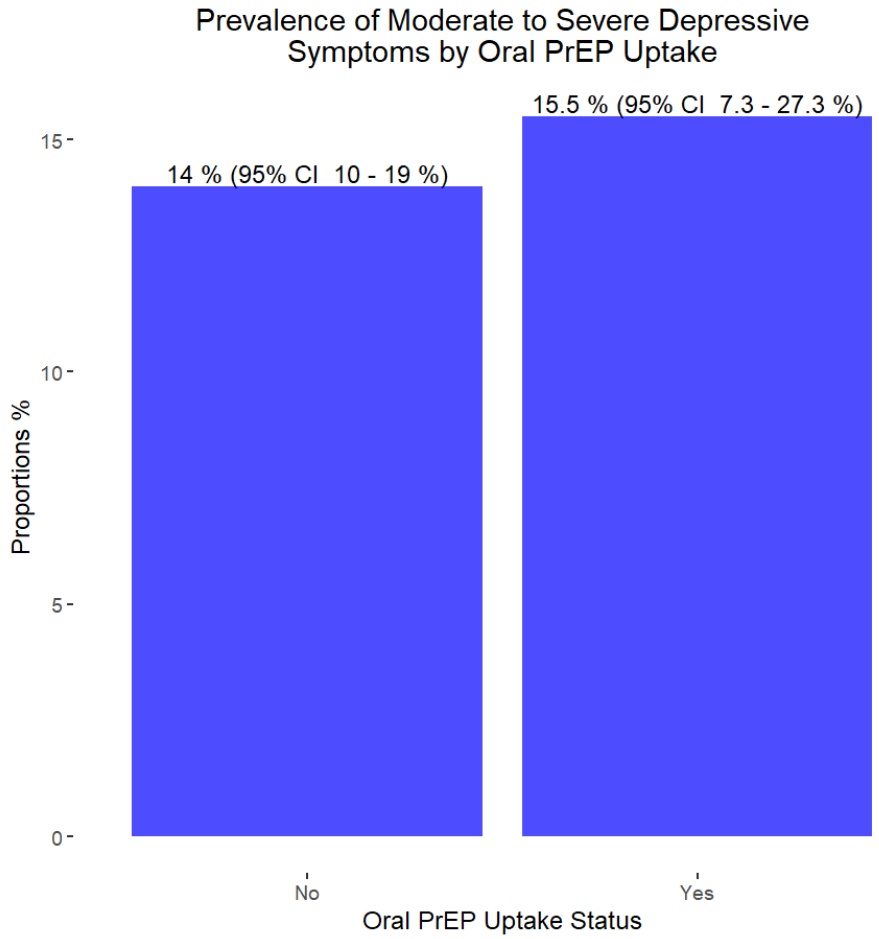

Figure 5: Prevalence of moderate to severe depressive symptoms based on the oral PrEP uptake status. Oral PrEP uptake was defined as the use of oral PrEP since the last scheduled KEN SHE visit. There was no statistical difference between the two groups (Chi-Square, P=0.77).

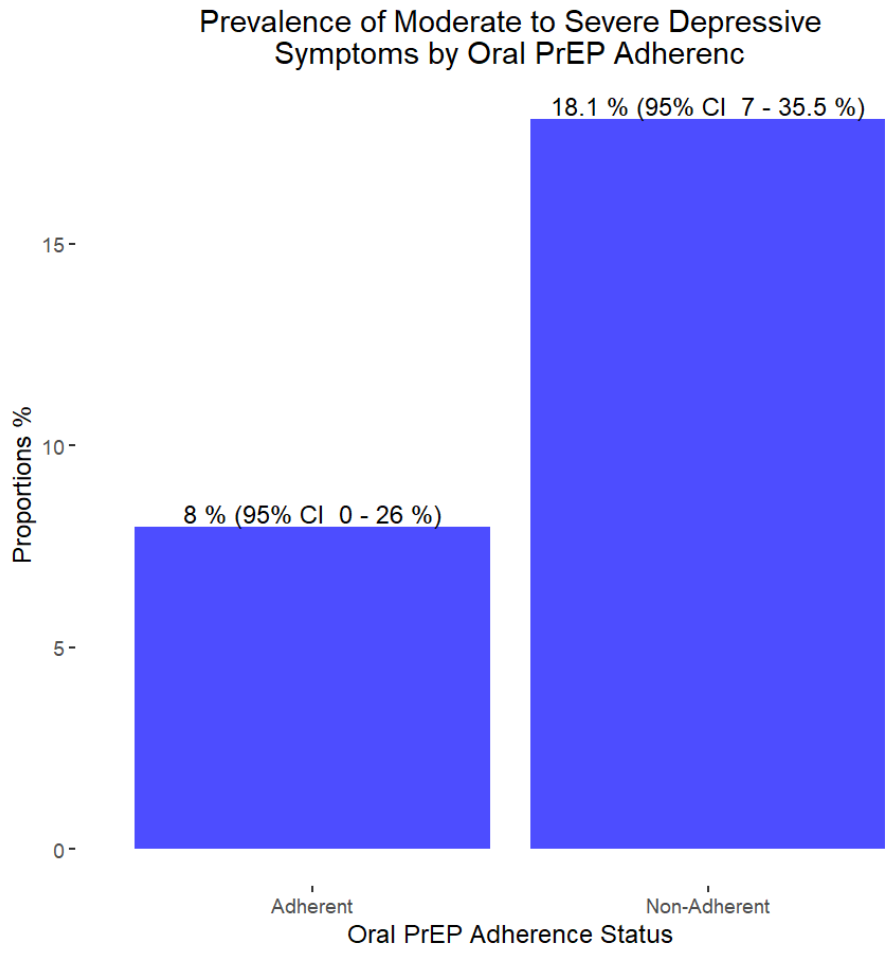

Figure 6: Prevalence of moderate to severe depressive symptoms based on the PrEP adherence status, PrEP adherence was defined as taking PrEP for at least 5 days in the previous 7 days. There was no statistical difference between the two groups (Fisher's exact test p-value = 0.39).

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