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HIV Prevention Among Women Who Use Substances And Report Sex Work: Risk Groups Identified Among South African Women

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Abstract

This cross-sectional study presents baseline data from women ($n = 641$) in a community-based randomized trial in Pretoria, South Africa. Women were eligible if they reported recent alcohol or other drug (AOD) use and condomless sex. Latent class analyses were conducted separately for those who reported sex work and those who did not. Among those who reported sex work, a Risky Sex class ($n = 72$, 28%) and Low Sexual Risk class ($n = 190$, 73%) emerged. Those in the Risky Sex class were more likely to report that their last episode of sexual intercourse was with their boyfriend (vs. a client/other partner) compared with the Low Sexual Risk class ($p < 0.001$). Among participants who did not report sex work, a Drug-Using, Violence-Exposed, and Impaired Sex class ($n = 53$; 14%) and Risky Sex and Moderate Drinking class ($n = 326$; 86%) emerged. The findings suggest that interventions for women who engage in sex work should promote safer sexual behavior and empowerment with main partners. Women who use AODs, experience physical or sexual violence, and have impaired sex may be a key population at risk for HIV and

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Conflict of interest The authors declare that they do not have any conflicts of interests.

Compliance with Ethical Standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This includes obtaining informed consent from all participants.

should be considered for tailored behavioral interventions in conjunction with South Africa's plan to disseminate HIV prevention methods to vulnerable women. Trial Registration: [ClinicalTrials.gov](https://ClinicalTrials.gov/record/NCT01497405) registration NCT01497405.

Resumen

Este estudio transversal presenta datos sobre referencia de mujeres ($n = 641$ basados) en un ensayo controlado aleatorio en la comunidad de Pretoria, Sudáfrica. Las mujeres fueron elegibles si reportaron el consumo reciente de alcohol o drogas y practicaron sexo sin condón. Se realizaron análisis de clase latente por separado para aquellas que reportaron ser trabajadoras sexuales y aquellas que no. Entre aquellas mujeres que reportaron ser trabajadoras sexuales, se encontró que ($n = 72$, 28%) tuvieron Prácticas Sexuales Riesgosas y ($n = 190$, 73%) Tuvieron Prácticas Sexuales de Bajo Riesgo. Aquellas mujeres que tuvieron Prácticas Sexuales Riesgosas, reportaron más frecuentemente que su último intercambio sexual fue con su novio y no con un cliente u otro compañero, comparado con las que tuvieron Prácticas Sexuales de Bajo Riesgo ($p < 0.001$). También se encontró consumo de drogas, violencia y algunos trastornos sexuales ($n = 53$, 14%) así como Prácticas Sexuales Riesgosas y consumo moderado de alcohol ($n = 326$; 86%), entre las participantes que no reportaron ser trabajadoras sexuales. Los hallazgos sugieren que las intervenciones en mujeres que están involucradas como trabajadoras sexuales podría promover las prácticas sexuales más seguras y el empoderamiento con su pareja principal. Las mujeres que usan sustancias alucinógenas, que están expuestas a violencia física y sexual, y que tienen trastornos sexuales podrían ser la población clave con riesgo de contagiarse de VIH, por lo tanto; deberían ser consideradas en las intervenciones de comportamiento adaptativo, en conjunto con el plan de Sudáfrica para diseminar los métodos de prevención de VIH entre mujeres vulnerables.

Keywords

Women; Alcohol use; Drug use; Physical or sexual violence; Sex work; HIV prevention; Mujeres; consumo de alcohol; Consumo de drogas; violencia física y sexual; Trabajadora sexual; prevención del VIH

Introduction

Currently, the main route of HIV infection in South Africa's generalized HIV epidemic is heterosexual transmission [1]. Consequently, women carry the burden of infection, with pockets of concentrated epidemics among particularly vulnerable women, such as women who engage in sex work, women who use alcohol and other drugs (AODs), and women who experience gender-based violence (GBV). For example, HIV prevalence among women who engage in sex work is estimated to be between 40% and 88% [2] and 55% among women who use AODs. Furthermore, women experiencing GBV are approximately 50% more likely to contract HIV compared with women who have not experienced GBV [3]. Poverty is a structural determinant of health that is related to high-risk sexual behavior and GBV, which increase the risk of HIV infection among women [4]. Specifically, poverty and unequal employment opportunities increase the likelihood of women engaging in risky sexual behaviors—such as sex work or remaining in relationships characterized by physical or sexual violence for economic viability—thus increasing HIV risk [4]. Sex work [5] and

physical and sexual violence [6] have also been linked to AOD use, which presents an additional risk of HIV. Taken together, risk factors such as sex work, violence, and AOD use contribute to the HIV epidemic among women, underscoring the importance of identifying those who are most at risk for HIV infection [7].

As with most cultures, certain aspects of South African culture promote gender inequities [8], and create large gender-based disparities in income and education. This is especially true for women who are Black African, the largest yet poorest demographic group in South Africa [9]. This disparity of resources often leaves many women with few prospects for gainful employment. Consequently, to provide for themselves and their families, women living in poverty may put themselves in risky situations. For example, out of economic necessity, some women may engage in sex work or trade sex for money or goods, which often includes condomless sex, as it is one of the few ways for them to make money [10]. Other women may enter or remain in relationships characterized by physical or sexual violence to secure food, housing, and other basic needs [8]. Furthermore, South African women have reported that using AODs helps them to deal with sex work and cope with physical and sexual violence [11, 12], however, AOD use coupled with sex work or GBV increases their HIV risk.

Physical and sexual violence are strongly related to HIV risk and are common occurrences among many South African women [13]. Estimates suggest that 20%–55.5% [14, 15] of women in South Africa have experienced some form of physical or sexual violence. The percentages are even higher among women who engage in sex work [10, 11] and/or use AODs [12, 16]. Experiencing physical or sexual violence or the fear of such violence increases HIV risk by undermining women's ability to negotiate safer sex practices such as condom use [17]. Given that sex workers and women who engage in AOD use are more likely to experience physical and sexual violence than women in the general population of South Africa, violence is intricately tied to sexual risk among these vulnerable women [18].

Alcohol and drug use often co-occurs with physical and sexual violence [19] and exacerbates HIV risk [20]. The nexus of AOD use and physical and sexual violence is especially prevalent among women who report sex work but is also problematic for women who use AODs [12]. In previous research, both women who engage in sex workers and those who do not using AODs reported experiencing violence at high rates, which was related to their sexual risk [12]. Consequently, to inform HIV prevention efforts, it is imperative to understand how AOD use and physical and sexual violence impact the HIV risk of both women who engage in sex work and those who do not.

Research has highlighted the intersection of AOD use, violence, and sexual risk among vulnerable women in South Africa [10, 21]. Most research to date views vulnerable women, especially women who engage in sex work, as a homogeneous risk group. However, women who report sex work and/or women who use AODs may represent a heterogeneous population who experience different risk factors. Furthermore, research and policy have focused heavily on women who report sex work [2], but little research or policy has focused on women who use AODs.

The present study attempts to fill this gap by using latent class analysis (LCA) to identify HIV risk profiles of women who report using AODs and engaging in sex work as well as those who do not. We hypothesize that groups of women will emerge from our sample and these groups will differentiate from each other based on their (1) condom use, (2) AOD use, (3) history of physical or sexual violence, (4) reporting of impaired sex (i.e., using AODs before or during sex), and (5) HIV status awareness.

Methods

Sample Characteristics, Eligibility, and Recruitment

Study participants were from poor communities in Pretoria, South Africa, and were recruited through community-based outreach efforts, such as in-person recruitment and flyers in local shops, clinics, and service agencies. To be included in the study, participants had to be Black African women aged 15 or older (with no maximum age cutoff; if 15–17, with evidence of tacit emancipation); had to use at least one substance (which could be alcohol) weekly for the past 3 months; had to have had sex with a male partner without protection (i.e., condom use) in the past 6 months; speak either English, Sesotho, Zulu/Xhosa, or Sestwana; had to provide informed consent to participate in the study; and had to plan to remain in Pretoria for the next 12 months. A total of 1014 women were screened for the study. Of these women, 240 were not eligible (e.g., did not report weekly AOD use, did not report unprotected sex). Of those who were eligible, 641 women enrolled in the study.

Procedure

This paper presents baseline data from a large community-level cluster randomized field trial examining the efficacy of a woman-focused HIV prevention intervention for women who use AODs in South Africa [22]. We used the baseline data to conduct an LCA.

Women were recruited from 14 different geographical zones—investigator-identified communities that were selected based on socioeconomic conditions and estimates of AOD use and sex work among women. Women who met the eligibility criteria and were interested in participating in the study were given an appointment for an intake interview either at the field site or in a private setting in the community. At this appointment, women were rescreened, asked to provide informed consent, complete a baseline computer-assisted personal interview, and participate in biological testing for drugs (i.e., panel drug urine screen), alcohol (i.e., Breathalyzer), pregnancy (i.e., urine test), and HIV (i.e., blood test).

Participants were provided with refreshments and R100 (approximately \$10 US) for their time. Ethical approval for the study was granted by the South African Medical Association Research Ethics Committee (SAMAREC), Tshwane Research Committee (TRC), and the RTI International Review Board for the Protection of Human Subjects. Additionally, this study established a Data and Safety Monitoring Board (DSMB) comprising expert physicians in infectious diseases, epidemiology, HIV treatment in South Africa, and bioethics. The DSMB provided ongoing evaluation of the procedures and data collection and received progress reports during biannual meetings with the investigators.

Measures

The Revised Risk Behavior Assessment (RRBA) [23] was modified for use in South Africa and combined with instrumentation from the U.S. National Institute on Drug Abuse (NIDA) data harmonization effort [24]. The current collaborative instrument, called the Pretoria Risk Behavior Assessment-Revised, assesses demographic information (age, relationship status, employment, and education), sex-worker status, AOD use, and victimization. Historically, adaptive iterations of this instrument show high reliability and validity in South African samples, including in the Western Cape and Pretoria [10–12].

Variables Included in the Latent Class Analysis—Given that the goal of the LCA is to identify subgroups of risk within women who reported sex work at screening and women who did not report any sex work, variables in the LCA models are additional (other than sex work) risk factors that have been associated with HIV in previous research. Variables of biological drug use, including cocaine, opiates, and marijuana [25]; history of physical or sexual abuse [13]; heavy alcohol use [26]; unprotected sex, including impairment prior to the unprotected sex [26]; and awareness of HIV-positive status [27] were included.

Participant's sex work status was established by the screener item, "Have you done sex work in the past 6 months—that is, traded sex for money or things?" This question was reiterated, but slightly modified, in the baseline instrument ("Have you done any sex work [or traded sex for drugs, money, food, clothing, shelter, or any other goods] in the past 6 months?") and had a small amount of discordance ($n = 35$ or approximately 6%). Based on outreach staff reports, the research team attributed this discrepancy to the fact that some women denied sex work during their intake visit at the study site after reporting that they engaged in sex work when they were screened in the community; however, most were found conducting sex work in the community. Consequently, the screener item was used. Responses were coded as 0 = no sex work and 1 = sex work.

Recent drug use was established by a panel urine drug screening test. The panel included benzodiazepine, cocaine, methamphetamine, MDMA (ecstasy), opiates, THC (marijuana), and Mandrax (methaqualone). Given the rising prevalence of cocaine, opiate, and marijuana use in South Africa and their association with risky sexual behavior, we included the use of these three drugs as separate indicators of this model. Participants were coded as 1 if they tested positive for cocaine and 0 if they did not test positive. This coding scheme was also followed for opiates and marijuana.

Participants self-reported on the extent to which they experienced problems related to alcohol use using the Alcohol Use Disorders Identification Test (AUDIT) [28], a 10-item instrument that assesses the frequency of alcohol consumption and related risks. Participants responded to items that were scored 0–4. Responses were summed and dichotomized such that scores equal to or greater than 20 were coded as 1 = likely alcohol dependence, and scores that were less than 20 were coded as 0 = other [28]. The AUDIT is not a diagnostic measure; therefore, we chose to label women who did not score 20 or more on the AUDIT as other instead of nondependent. Previous research suggests other cutoff scores for women [29]. However, in South Africa, given the historical significance of alcohol as payment for labor [30] and the elevated level of alcohol consumption [31], we used the score indicated in

the AUDIT manual and other research in Southern Africa that has validated the use of 20 as a cutoff for likely alcohol dependence among various populations, including women [32].

As a correlate to the AUDIT score and to provide validation of the 20-point cutoff, frequent heavy drinking was also used in the LCA. If an individual reported that she had 4 or more drinks a day on 11 days during the past month, she was classified as a frequent heavy drinker. Participants were coded as 1 = frequent heavy drinker and 0 = nonfrequent heavy drinker.

Participants' history of physical violence was measured by one composite variable derived from items that assessed whether they had been physically abused in their lifetime and experienced physical abuse perpetrated by a boyfriend or client in the past 3 months. Sexual abuse was derived in the same manner. The composite variables assessing physical and sexual abuse were combined to create a variable that reflected lifetime physical or sexual abuse. Responses were coded 0 = no lifetime physical or sexual abuse and 1 = lifetime physical or sexual abuse.

Unprotected last sex was assessed by a series of items assessing risky sexual behavior during the participants' last sex act. Round-level (i.e., sex act) data was collected for each act of vaginal sex during the participant's last sex episode. If one round of vaginal sex was condomless, the participant was noted as having unprotected sex. Next, the unprotected sex variable was combined with an item assessing whether the participant used AODs just before or during the last sex episode. If the participant endorsed using AODs before or during sex, she was coded as 1 = participant impaired and unprotected last vaginal sex. Lastly, the unprotected sex variable was combined with an item assessing whether the participant's partner used AODs just before or during sex. If the participant reported that her partner used AODs before or during sex, she was coded as 1 = partner impaired and unprotected last vaginal sex.

A blood sample from a finger prick was collected to assess HIV status using two rapid HIV tests after the administration of the baseline instrument. A third HIV test was performed if the tests were discordant. Awareness of HIV-positive status was determined by assessing participants' perceived HIV status before undergoing HIV testing at enrollment, their biological HIV test result at enrollment, and their self-reported testing behavior. If a participant reported that they had not been tested for HIV, were not aware of their HIV status, and tested positive for HIV during the biological test at enrollment, they were coded as 0 = unaware of HIV-positive status and others were coded as 1 = aware of HIV status. Analyses conducted using crosstabulations of women who were HIV positive and unaware showed marked similarity in demographic characteristics to women who were HIV negative (not shown).

Analysis

Preliminary Analysis—Descriptive analyses were conducted to examine average age and the frequency of responses and average age of each indicator variable: unprotected sex, biological drug use, lifetime physical or sexual abuse, AUDIT scores category, frequent heavy drinking, impaired and unprotected sex, and awareness of HIV-positive status. Simple

crosstabulations and mean difference tests examined women who reported sex work and those who did not in terms of basic demographics and risk factors.

Primary Analysis: LCA was conducted to identify subgroups of women who were similar in terms of their risk factors for HIV. LCA is a statistical technique that identifies homogeneous groups (i.e., classes) within a sample based on categorical latent variables [33]. It has been argued that LCA is preferable to cluster analysis because of its enhanced reliability, ability to examine fit indices, and ability to account for missing data using maximum likelihood estimation [34].

Using Mplus 7.4 [35], we conducted LCA to estimate potential group profiles separately for women who reported sex work and those who did not. In each analytic group, several models were tested, starting with a one-class model solution and ending with a four-class model solution. Unprotected sex, biological drug use (cocaine, opiates, and marijuana), lifetime physical or sexual abuse, AUDIT category, frequent heavy drinking, impaired and unprotected sex, and awareness of HIV-positive status served as binary indicator variables. Guidelines outlined by Berlin, Parra, and Williams [36] were used to determine model selection. First, the Bayesian Information Criteria (BIC), Akaike Information Criteria (AIC), and entropy were compared among models. Lower values on the BIC and AIC indicate better model fit and entropy scores closer to 1 (range 0–1) indicate greater classification accuracy. Second, based on research that suggests that models with classes that have 25 or fewer participants may impair the power and precision of estimates, the size of the smallest class was explored for each model. Third, the conceptual meaning of each class within the final solution was evaluated. Finally, we examined between-class differences in baseline risk factors, including HIV status and demographics. To do this, we first exported the latent classes to SAS Enterprise Guide (7.1) to compare classes on demographic and risk factors.

Results

Description of Sample

Table 1 displays pertinent demographic and risk variable information by sex work status. The ages of women in the study ranged from 16 to 58. The overall mean age was 29.86 (SD = 7.8), and women who reported sex work tended to be slightly older than women who did not report sex work. Most women reported they were unemployed ($n = 576$, 90%). Of note among women who reported engaging in sex work, 52% ($n = 136$; not shown) reported that did not have any other source of income. Other forms of income included domestic work in someone else's home (3%), social grants (13%), boyfriends (27%), family (3%), doing hair (3%), casual partners or other sex partners (2%), and other activities to a lesser degree (e.g., stealing from people, converting cash, legally selling things, friends, trading goods or bartering, selling food, etc.; not shown). Overall, most women ($n = 563$; 88%) reported having a boyfriend, with slight differences between the two groups. Among women who reported sex work, 20% ($n = 52$) tested positive for cocaine, 23% ($n = 59$) tested positive for opiates, and 40% ($n = 105$) tested positive for marijuana. Among women who did not report sex work, 11% ($n = 40$) tested positive for cocaine, 15% ($n = 56$) tested positive for opiates, and 25% ($n = 96$) tested positive for marijuana. Approximately, 42% of women who

reported sex work, reported experiencing physical or sexual abuse in their lifetime and 31% of women who did not report sex work reported abuse. A minority of women who reported sex work had scores of 20 or greater on the AUDIT ($n = 83$; 32%) and reported being a frequent heavy drinker ($n = 90$; 34%). Similarly, approximately 30% ($n = 114$) of women who did not report sex work scored 20 or greater on the AUDIT and 30% ($n = 115$) reported being a frequent heavy drinker. Overall, 55% ($n = 354$) of women were living with HIV, with 36% ($n = 126$; not shown) being newly diagnosed at enrollment. Approximately 27% of the women living with HIV were diagnosed less than a year ago, 42% were diagnosed 1–4 years ago, 25% were diagnosed 5–9 years ago, and 6% were diagnosed more than 10 years ago (not shown). Approximately, 68% of women who reported sex work tested positive for HIV.

Latent Class Analysis of Risk Classes

Tables 2 and 3 present the fit indices and entropy for the LCA models that were conducted for women who reported sex work and those who did not, respectively. Based on the established model selection criteria [36], a two-class solution was chosen as the best fitting models for both women who reported sex work and those who did not report sex work. These models best represented the underlying subgroups in the data. Specifically, the twoclass solutions resulted in a higher entropy than all other solutions, indicating that a higher proportion of participants were correctly classified into classes for both women who reported sex work and those who did not report sex work (0.97 and 0.98, respectively). In addition, the two-class solution provided the most conceptually meaningful classes. Finally, the two-class solution provided meaningful subgroup profiles of sufficient sample size ($n > 50$) for subsequent analyses.

Women Who Reported Sex Work—Class 1 comprised approximately 28% of the sample ($n = 72$) as shown in Fig. 1. All women in Class 1 reported having unprotected sex during their last sex episode. Approximately 86% of the women in this class reported being impaired and 87% reported that their partner was impaired at last sex. In contrast, only 13% of the women in Class 2 reported having unprotected sex and none of the women in this class reported that they or their partners were impaired during their last sex episode. Class 1 and Class 2 were similar in terms of AOD use and experience with alcohol problems. Class 1 and Class 2 were also identical in terms of their awareness of their positive HIV status. Consequently, Class 1 was considered the “Risky Sex” group and Class 2 was considered the “Low Sexual Risk” group.

Women Who Did Not Report Sex Work—Class 1 comprised approximately 14% of the sample ($n = 53$), as shown in Fig. 2. All women in Class 1 tested positive for recent drug use but reported low alcohol use and less alcohol problems than Class 2. A greater percentage of women in Class 1 reported that they or their partner were impaired and had unprotected sex during the last sex episode, and that they had experienced lifetime physical or sexual abuse than Class 2. In contrast, the women in Class 2 were less likely to test positive for recent drug use and more likely to report frequent heavy drinking—based on 11 or more days of greater than 4 drinks a day and alcohol problems based on an AUDIT score greater than or equal to 20—than Class 1. Both Class 1 and Class 2 were identical in terms of their condom

use during the last sex episode and were similar on awareness of HIV positive status (a slightly larger percentage of women in Class 2 were aware of their HIV status). Consequently, Class 1 was considered the “Drug-Using, Violence-Exposed, and Impaired Sex” group and Class 2 was considered the “Risky Sex and Moderate Drinking” group.

Class Membership Characteristics

Women Who Reported Sex Work—Once class membership was established, the classes were evaluated on demographics, risk behaviors, and baseline HIV status (see Table 4). Among women who reported sex work, the Risky Sex and Low Sexual Risk groups were similar in terms of demographics, including HIV status. Women in the Risky Sex group were significantly more likely to report having a boyfriend ($p < 0.05$) compared with women in the Low Sexual Risk group. Previous research [37] indicates that women who report sex work tend to protect themselves with condoms when having sex with clients and other partners, but do not use protection with main partners or boyfriends. Therefore, we suspected that women in the Risky Sex group would be more likely to report that their last sex episode was with a boyfriend compared to women in the Low Sexual Risk group. A post hoc analysis was conducted to determine if there were differences in partner type (boyfriend vs. client/other partner) at last sex episode between the two classes. The post hoc analysis revealed that 78% of the women in the Risky Sex group reported that their last sex episode was with a boyfriend, compared with 23% of women in the Low Sexual Risk group ($p < 0.0001$).

Women Who Did Not Report Sex Work—Among the women who did not report sex work, the Drug-Using, Violence-Exposed, and Impaired Sex group and the Risky Sex and Moderate Drinking group were evaluated on demographics and other risk behaviors. The Risky Sex and Moderate Drinking group was older ($M_{age} = 29.8$) and less likely to report being homeless compared with the Drug-Using, Violence-Exposed, and Impaired Sex group ($M_{age} = 26.3$; $ps < 0.05$), as shown in Table 4. The women in the Drug-Using, Violence-Exposed, and Impaired Sex group were more likely to report that they or their partners were impaired and had unprotected vaginal sex during their last sexual episode than the women in the Risky Sex and Moderate Drinking group ($ps < 0.05$). Women in the Drug-Using, Violence-Exposed, and Impaired Sex class were also significantly more likely to test positive for recent cocaine, opiate, and marijuana use ($ps < 0.05$).

Discussion

Recent HIV prevention efforts by the South African government have identified women who engage in sex work as a key population at risk for HIV [38]. The findings of the current study show that women who do not engage in sex work but use AODs also represent a vulnerable population that is at high risk for HIV.

Among women who reported sex work, two groups emerged, the Risky Sex group and the Low Sexual Risk group. Both groups reported similar levels of physical or sexual abuse that were higher than the global average, which indicates that women who engage in sex work may be at increased risk of physical and sexual violence. The Risky Sex group represents a group of vulnerable women who have been previously identified because of their likelihood

of engaging in condomless sex [39]. Interestingly, our post hoc analyses revealed that the risky sexual behavior reported by the women in the Risky Sex group may be attributable to the fact that they were engaging in sex with their boyfriends instead of another partner or client. This finding is consistent with previous research and suggests that HIV prevention efforts among women who report sex work should focus on promoting safer sexual behavior with main sex partners and clients [40], particularly when engaged in AOD use.

Stakeholders should consider how the relationship dynamics between women and their main partners and women and their clients may differ, and offer women empowering HIV prevention interventions and alternative strategies—such as negotiation skills, condoms, pre-exposure prophylaxis (PrEP)—that address the different interpersonal contexts of each relationship. Specifically, interventions should empower women to protect themselves in different relationships and contexts and to take advantage of woman-controlled HIV prevention methods, especially with their main partners.

The Low Sexual Risk group represents a group of women who engage in safer sexual behavior, despite engaging in sex work. This finding demonstrates that women who report engaging in sex work are not a homogeneous group of women engaging in “high-risk” sexual behavior. In fact, this Low Sexual Risk group was the largest group of women who reported sex work, indicating that most of these women are careful to protect themselves from HIV, especially when they have sex with a client or other partner. This is encouraging and may reflect the ongoing efforts in South Africa to promote safer sexual behavior among women who report sex work [2]. However, more emphasis should be placed on promoting safer sexual behavior with main partners among women who report sex work.

Among women who did not report sex work, the Drug-Using, Violence-Exposed, and Impaired Sex group and the Risky Sex and Moderate Drinking group emerged. These groups were differentiated based on the type of substance that each group reported using or tested positive for during a urine drug screen and their experiences of physical or sexual violence. Interestingly, these two groups had almost the same percentage of women who reported that their last sex episode was unprotected. Furthermore, women in both groups were mostly unaware of their HIV-positive status. These findings demonstrate that AOD use may contribute to unprotected sex and that women who engage in AOD use may be at risk for HIV and be unaware of their status. Furthermore, our findings suggest that physical and sexual violence may play an important role in the sexual risk of women who use drugs. Consequently, HIV prevention efforts, especially HIV testing and status awareness, should not focus exclusively on women who report sex work but also address the needs of women who use AODs, including addressing physical and sexual violence.

As it relates to the HIV risk of each of the classes in this study, we found HIV prevalence was significantly higher among women who reported sex work compared with women who did not report sex work. However, the findings from our previous research suggest that over the past 10 years, HIV prevalence among women who report sex work in Pretoria has remained high but stable, whereas HIV prevalence among women who use AODs, but do not trade sex has risen significantly [41]. Although considerable effort has been focused on disseminating PrEP and other HIV prevention education and tools to women who report sex

work, our analyses suggest that women who use AODs may also be suitable candidates for a variety of prevention strategies, including PrEP. In fact, our findings provide some evidence that AOD use may be a driving force for sexual risk, even among women who do not report sex work. The prevention structure being developed for women who report sex work, as outlined in the South African National Sex Worker HIV Plan [3], may need to be adapted to address the needs of women who use AODs. Additionally, the government may wish to consider broadening the criteria for the provision of free PrEP to include women who misuse AODs to reduce their HIV risk.

Finally, this study illustrates the need for interventions that address the nexus of AOD use and sexual risk as a strategy for reducing HIV among both women who report sex work and women who do not report sex work. A systematic review of the characteristics of HIV and alcohol risk-reduction interventions in sub-Saharan Africa found that very few interventions were available that addressed the nexus of these factors among women who report sex work and those who do not engage in sex work, but who do use AODs [42]. Only one intervention, the Women's Health CoOp, targeted women who used AODs and addressed HIV, AOD use, and violence [42, 43]. Most importantly, addressing the factors that influence the intersection of AOD use and sexual risk among vulnerable women through a socioecological framework is necessary to provide opportunities for disease prevention and timely harm-reduction interventions.

Limitations

Although this study may have clinical and policy implications, its findings must be interpreted considering its limitations. First, the data collected for this study are cross-sectional; consequently, the causality or temporality of the associations among indicators cannot be established. Future research should attempt to replicate these risk groups and use them to prospectively predict sexual risk among these groups. Second, this study was conducted in the city of Pretoria, South Africa. Therefore, the findings may not be generalizable to other areas of South Africa or other parts of Africa and the world. Third, our measurement of lifetime history of physical and sexual abuse was limited to a few items for each type of abuse, and the use of more comprehensive measures of physical and sexual abuse should be implemented in future research. Fourth, while we are aware of the role of psychological violence on AOD abuse and HIV risk, we did not include this factor in our analyses. Future research should expand the scope of this research by examining how this form of violence may influence the configurations of the groups identified in the current study. Fifth, some research suggests that the sensitivity of LCA may be elevated [44]; therefore, research should attempt to replicate these findings to confirm the stability of these classes. Sixth, our sample consisted of women who used AODs. Although women who use AODs represent an extremely vulnerable group, future research should explore these relationships among a more representative sample of South African women. Relatedly, very few of the women in this study reported injection drug use, which is a key risk factor for HIV. Future research should use a person-centered approach to examine how different drug patterns, including injection drug use, may be related to sexual risk among women who report sex work and women who do not report sex work in South Africa. Seventh, although we only assessed sex work in the past 6 months, it is possible that women may have engaged

in sex work more than 6 months ago, but had not recently engaged in sex work. There may be differences in HIV risk for women who have ever traded sex compared with those who have never engaged in sex work. Therefore, future research should examine these relationships among women who have no history of sex work, a lifetime history of sex work, and a recent history of sex work. Finally, it should be noted that data from the current analysis were collected from 2012 to 2015 in Pretoria, during the same period as the initial PrEP trials in Pretoria. Therefore, it is possible, although unlikely, that participants had taken PrEP because of their enrollment in another trial prior to or during enrollment in our study.

Conclusions

Collectively, this study indicates that it may be beneficial for researchers, clinicians, and policymakers to view AOD use as a risk indicator that can help to identify women who are at risk for contracting HIV and inform the dissemination of behavioral and biomedical interventions, such as PrEP, to prevent the acquisition of HIV. Stakeholders may also want to focus on promoting safer sexual behavior among women who report sex work and their main partners, with whom they may engage in unprotected sex. Combination prevention is becoming more accessible to women in South Africa; however, the accessibility of these resources may only be targeted to women who report sex work and be framed in such a manner that focuses on engaging in safer sex with their clients, but not with their boyfriends. Few policy efforts have identified women who use AODs as a key HIV prevention population. While women who report sex work are a key HIV risk group, limiting HIV prevention resources to these women is problematic. Key stakeholders may be missing an opportunity to reduce HIV among women in South Africa by not fully intervening with women who report using AODs and engaging in condomless sex.

It is possible that the impact of HIV prevention interventions can be increased if these efforts are expanded to include women who use AODs and focus attention on the main partners of women who report sex work. Specifically, HIV prevention interventions could be embedded in substance abuse treatment centers and promote HIV prevention methods that can be used with a main partner. Given the burden of HIV among South African women, stakeholders at every level need to consider women who use AODs as another priority group at risk for HIV and intervene with women who report sex work and their main partners.

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Fig. 1.
Latent class profile for women who reported sex work

Fig. 2.
Latent class profile for women who did not report sex work

Table 1

Sample descriptive statistics, by reported sex work status

Variable	Sex work status			Significance
	Total (n = 641)	Women who report sex work (n = 262)	Women who do not report sex work (n = 379)	
Sociodemographic characteristic				
Average age in years (SD)	29.86 (7.8)	30.65 (7.8)	29.31 (1.5)	0.03
% Currently have a boyfriend	563 (87.8)	209 (79.8)	354 (93.4)	<0.0001
% HIV positive status	354 (55.2)	177 (67.6)	177 (46.7)	<0.0001
% Education (Standard 10)	402 (62.7)	149 (56.9)	253 (66.8)	0.01
% Unemployed	576 (89.9)	246 (93.9)	330 (87.1)	0.005
% Ever experienced physical or sexual abuse	226 (35.3)	109 (41.6)	117 (30.9)	<0.01
Average age when first traded sex (SD)	23.4 (6.3)	23.4 (6.3)	—	—
% Unprotected last vaginal sex	400 (62.4)	97 (37.0)	303 (79.9)	<0.0001
% Participant impaired and unprotected last vaginal sex	240 (37.4)	63 (23.9)	177 (46.8)	<0.0001
% Partner impaired and unprotected last vaginal sex	238 (37.1)	63 (24.1)	175 (46.2)	<0.0001
AUDIT 20	197 (30.7)	83 (31.7)	114 (30.1)	0.666
Frequent heavy drinking	205 (32.0)	90 (34.4)	115 (30.3)	0.284
Biological—% positive for cocaine	92 (14.4)	52 (19.9)	40 (10.6)	0.001
Biological—% positive for opiates	115 (17.9)	59 (22.5)	56 (14.8)	0.012
Biological—% positive for marijuana	201 (31.3)	105 (40.1)	96 (25.3)	<0.0001

AUDIT Alcohol Use Disorders Identification Test

Table 2

Fit indices for women who reported sex work, k = 4 models

Number of classes	AIC	BIC	SABIC	LMR LRT	BST LRT	Entropy
1 class	3209.710	3245.393	3213.689	–	–	1.00
2 class	2877.099	2952.034	2885.454	354.611 ($p < 0.001$)	354.611 ($p < 0.001$)	0.97
3 class	2753.772	2867.959	2766.505	145.326 ($p < 0.001$)	145.326 ($p < 0.001$)	0.95
4 class	2658.817	2812.256	2812.256	116.955 ($p = 0.001$)	116.955 ($p = 1.0$)	0.95

AIC, akaike information criteria, BIC, bayesian information criteria, SABIC, sample-adjusted bayesian information criteria, LMR LRT, Lo-Mendell Rubin likelihood ratio test, BST LRT, bootstrap likelihood ratio test

Table 3

Fit indices for women who did not report sex work, k = 4 models

Number of classes	AIC	BIC	SABIC	LMR LRT	BST LRT	Entropy
1 class	4249.156	4288.532	4288.532	–	–	1.00
2 class	3881.191	3963.879	3897.250	389.965 ($p < 0.001$)	389.965 ($p < 0.001$)	0.98
3 class	3621.403	3747.404	3645.875	281.788 ($p < 0.001$)	281.788 ($p < 0.001$)	0.95
4 class	3571.885	3741.199	3604.769	71.518 ($p < 0.001$)	71.518 ($p < 0.001$)	0.95

AIC akaike information criteria, BIC bayesian information criteria, SABIC sample-adjusted bayesian information criteria, LMR LRT Lo-Mendell Rubin likelihood ratio test, BST LRT bootstrap likelihood ratio test

Table 4

Class level characteristics, by group and report of sex work

N (% of sample) Variable	Women who report sex work		Women who do not report sex work		Risky sex and moderate drinking N (%) 326 (86.0)
	Risky sex N (%) 72 (27.5)	Low sexual risk N (%) 190 (72.5)	Drug-using, violence-exposed, and impaired sex N (%) 53 (14.0)	Impaired sex N (%) 26.3 (5.6)	
Average age in years (SD)	30.8 (7.2)	30.6 (6.8)		26.3 (5.6)	29.8 (8.6) *
Currently has a boyfriend (Yes)	66 (91.7)	143 (75.3) *		49 (92.5)	305 (93.6)
Currently homeless (Yes)	22 (30.6)	53 (27.9)		20 (37.7)	76 (23.3) *
Unemployed (Yes)	69 (95.8)	177 (93.2)		49 (92.5)	281 (86.2)
Education (Standard 10 or Grade 12 or higher)	37 (51.4)	112 (59)		41 (77.4)	212 (65.0)
Unprotected last vaginal sex	72 (100)	25 (13.3) *		42 (80.8)	261 (81.6)
Impaired and unprotected last vaginal sex—woman	62 (86.1)	0 (0.0) *		37 (71.2)	137 (42.8) *
Impaired and unprotected last vaginal sex—partner	62 (87.3) +	0 (0.0) *		37 (71.2)	135 (42.2) *
Lifetime physical or sexual abuse (Yes)	28 (38.9)	81 (42.6)		21 (39.6)	96 (29.4) *
AUDIT—20 (likely alcohol dependence; Yes)	26 (36.1)	57 (30.0)		2 (3.8)	112 (34.4) *
Four or more drinks on 11 or more days in the past month	28 (38.9)	62 (32.6)		0 (0.0)	115 (35.3) *
Biological—% positive for cocaine	18 (25.0)	34 (17.9)		38 (71.7)	2 (0.6) *
Biological—% positive for opiates	17 (23.6)	42 (22.1)		51 (96.2)	5 (1.5) *
Biological—% positive for marijuana	33 (45.8)	72 (37.9)		53 (100)	43 (13.2) *
Aware of HIV-positive status	35 (48.6)	93 (48.9)		11 (20.8)	93 (28.5)
Average age when first traded sex (SD)	23.0 (6.9)	23.6 (6.1)		—	—
HIV positive (Yes)	50 (69.4)	127 (66.8)		20 (37.7)	157 (48.2)

* $p < 0.05$; + missing data