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Research Article

Assessment of Syndemic Inter-relationships between Substance Use, Violence and HIV Risk Among Persons Seeking Emergency Care in Nairobi, Kenya

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Abstract

Introduction

Contemporaneous substance abuse, violence and HIV/AIDS risks (SAVA) result in synergistic negative impacts (syndemic effects). Presence of and risks for syndemic SAVA conditions are common among emergency department (ED) patients; however, research on these inter-related processes is limited in sub-Saharan Africa. This study utilizes structural equation modeling to examine the relationships of syndemic SAVA conditions among persons seeking emergency injury care in Nairobi, Kenya.

Methods

This secondary analysis of a prospective observational study examined SAVA syndemic conditions among non-pregnant, adult ED injury patients able to provide consent at Kenyatta National Hospital. Structural equation modeling using diagonally weighted least squares (DWLS) was used to quantify associations between three latent variables (substance use, HIV risks, violence exposure). HIV risk included partner HIV status, men who have sex with men (MSM), and gay identities; violence exposure covered emotional, physical or sexual violence in the past six months; substance use encompassed positive screening for alcohol use disorder, poly-substance use, injection drug use and injury-related substance use. Model fitness was assessed using the Bentler-Bonett Normalized Fit Index (BB NFI), Goodness of Fit Index (GFI) (>0.9) and standardized root mean square residual (SRMSR) (< 0.05). Covariance between the latent factors was estimated.

Results

Among 2,368 screened ED patients, 665 were enrolled. Males were 83% of the sample; median age was 30 years (IQR: 24-38). Fit indices using DWLS showed a close fitting model (GFI=0.99, BB NFI=0.95, SRMSR=0.04). The indicator variables had significant loadings on two of the three syndemic factors (substance use and violence exposure, β range 0.10-0.95); in the SEM only MSM status had a significant loading on HIV risk, which was insufficient to confirm the identification of the latent factor. Violence exposure and substance use risk had significant positive covariance (0.30, $p<0.001$).

Discussion and Conclusion

This study provides the first available data from ED patients in sub-Saharan Africa on SAVA conditions, showing a co-relationship of violence exposure and substance use but no significant associations with HIV risk. These results can be used to inform programmatic interventions for higher-risk persons addressing synergistic conditions during emergency care.

Keywords:
Emergency medicine; Violence; Injury; HIV/AIDS; Substance abuse; SAVA; Syndemic; Structural equation modeling; Kenya; Africa

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Introduction

The SAVA syndemic is the interconnected relationship between substance abuse, violence, and HIV/AIDS, where these factors collectively exacerbate health disparities and present mutually reinforcing challenges. [1], [2] This syndemic highlights how substance use increases vulnerability to both violence and HIV transmission, while violence further complicates HIV risk and treatment adherence. Alcohol

and illicit drug consumption are associated with increased HIV risk through sexual behaviors, including unprotected sex, inconsistent condom use, multiple partners and sexual violence. [3], [4], [5] Alcohol use and intoxication have been linked to increased violence. [6], [7] Violence and HIV are interconnected public health challenges, with high levels of violence among individuals accessing HIV services; prior evidence from Kenya showed that targeted prevention and response strategies can synergistically reduce both violence and HIV risk factors. [8], [9] Substance use is strongly associated with experiencing violence among sex workers and people who inject drugs (PWID) with studies highlighting its role in exacerbating HIV and broader health risks. [10], [11]

Prior work evaluating the SAVA syndemic has focused on women and urban settings in the United States. [12], [13], [14], [15], [16], [17], [18], [19], [20], [21] Internationally, the SAVA syndemic has been investigated among populations of Hispanics [22], Kazakh women [23], Uganda youth,[24], [25] and among both female and male populations in South Africa. [26], [27], [28] Within Kenya, there is a recognition that the risk factors for the SAVA syndemic are prevalent and have been studied in focused populations, including: PWID,[11] sex workers, [10], [29], [30], [31], [32] heavy alcohol users, [33] and among men who have sex with men (MSM). [34] These studies highlight the importance of addressing interconnected challenges in marginalized groups through interventions that target social and structural factors. [17] Substance use and violence among persons seeking care in emergency care is common, and those persons also have been shown to have higher-risk profiles for contracting and transmitting HIV. [35], [36], [37], [38], [39], [40], [41], [42] In sub-Saharan Africa where HIV, violence and substance use levy some of the largest burdens globally, there is limited data evaluating SAVA syndemic conditions, and no extant data from emergency care populations. [43], [44], [45], [46], [47] Therefore to address the gap in the evidence-base and inform understanding of SAVA syndemic conditions and potential programmatic solutions this study used advanced statistical modeling to investigate relationships between syndemic SAVA conditions among persons seeking emergency care in Kenya.

Methods

Study design and Setting

This study was a cross-sectional secondary analysis of prospective data from a continuously enrolled population of patients presenting with injuries to the Kenyatta National Hospital (KNH) ED in Nairobi, Kenya. Data was collected from March to August 2023 and derived from a study assessing HIV care delivery in this setting. [48] KNH is the largest hospital in Kenya, and serves as the primary injury center for Nairobi and a national referral hub. The KNH ED provides 24-hour emergency services and has embedded HIV Testing Services freely available day and night. [49], [50], [51]

Selection of Participants

Patients were recruited from all individuals seeking ED care; eligible patients were adults aged 18 years or older, obtaining injury care at the KNH ED and able to provide informed consent. Exclusions included non-injury cases, incarcerated persons, pregnant individuals, and critically ill patients or those unable to consent. All enrolled participants provided informed consent, with study information and consents available in Kiswahili and English, and research staff were fluent in both languages. The study was approved by both the KNH Ethics and Research Committee and the Institutional Review Board of Rhode Island Hospital.

Data Collection and Management

Participants received standard ED care for injuries from non-study providers. Screening and consent were conducted in a private area to ensure confidentiality, with enrollment occurring as soon after triage as able. Data collected included demographics, medical history, social history, injury details, interpersonal violence history, and ED care outcomes. [49] All data were securely stored in electronic databases using password-protected devices accessible only to study staff. [52], [53]

SAVA Variables

Empirical approaches to the SAVA theory have relied on steps that require simplification of complex interactions and can fail to capture the nuanced interactions between substance abuse, violence, and

HIV/AIDS. [54] A prior scoping review of SAVA research revealed that the majority of studies relied on regression analyses rather than employing other methods that could be superior in evaluating the complex inter-relationships. [17]

Demographic, HIV risk, substance use, and violence risk factors were utilized for modeling and analysis. Data for all variables were based on participant self report. Demographic variables included age at time of ED visit and biological sex. HIV risk factors included sexual identity (gay and/or MSM), sex partners HIV status, condom use practices during the last six months, history of injecting drug use, transactional sex (money or other goods exchanged to give or receive sex), and following the Kenya national guidelines on recommended HIV testing frequency (if age 18-24 years testing every 6 months, if age ≥25 years and no other risk factors testing every 2 years, if high risk ≥18 years testing every 3 months). [55] Substance use risk factors included: illicit drug use during the last 6 months, drug use during the time of injury, history of polysubstance use, and being at risk for hazardous alcohol use based on the validated Alcohol Use Disorders Identification Test Consumption (AUDIT-C) questions (females scoring ≥3 and males ≥4). [56], [57], [58] Violence exposure risk factors included report of either emotional, physical or sexual violence in the past 6 months. [47], [59]

Data Management & Analysis

Data was imported into SAS (Version 9.4, SAS Institute Inc, Cary, N.C.) for analysis. Descriptive statistics are reported as means with standard deviations (SD), medians with interquartile range (IQR), or percentages where appropriate. Prior to modeling, data used in the analysis were transformed into binary values (age 18-24 versus older, yes or no to substance use variables, positive or negative for AUDIT-C, HIV risk present or not, etc.). Due to low frequencies for variables defining key populations including ever injecting drugs (n = 4), MSM (n = 5), gay (n = 4), and commercial sex work (n = 9), a summary composite ordinal variable was derived and used in modeling analyses for HIV risk.

Structural equation modeling (SEM) was used to identify measured indicator variables associated with three latent factors: HIV risk, violence exposure, and substance use risk. SEM is a statistical approach used to evaluate relationships between observed and latent (unobserved) variables to better understand direct and indirect effects within a system of relationships. [60], [61] The SEM method has been used in a variety of other settings [62], [63], [64], [65], however, this methodology has not previously been utilized to evaluate the SAVA syndemic in emergency care settings. SEM combines factor analysis (to define the underlying latent factors from their measured manifest variables) and predictive models (assessing the covariance between the latent constructs). Model fitness was evaluated by assessing the Bentler-Bonett Normalized (BB NFI) and Goodness of Fit Indices (GFI, acceptable values >0.90) and the standardized root mean square residual (SRMSR, acceptable values <0.05). The covariance between the proposed three latent syndemic factors was also estimated.

An exploratory and confirmatory factor analysis was conducted; a random sample of 400 participants' data was selected for the exploratory model, and the full sample used in the confirmatory model. As binary variables were being used in these analyses, the diagonally weighted least squares (DWLS) estimation method was used. Following the SEM analysis a mediation model was added to assess the potential mediating effect of key populations for HIV on the relationship between the identified latent risk factors. [66]

Results

Characteristics of study subjects

During the study period 2368 patients presenting to the KNH ED were screened for participation. Among those, 1078 (45.5%) did not meet inclusion criteria and 625 (26.4%) declined participation. A total of 665 patients were consented and enrolled (Figure 1). Males were 83% of the sample and the mean age was 32 years (standard deviation of 10.5 years). Patient characteristics regarding SAVA syndemic factors are summarized in Table 1. A number of findings suggest increased risks for syndemic SAVA conditions among enrollees, including: not knowing sexual partner(s) HIV status (89.6%), high levels of illicit drug use during the injury event that led to the ED encounter (18.5%), and high rates of prior 6-month experiences of physical violence (18.9%).

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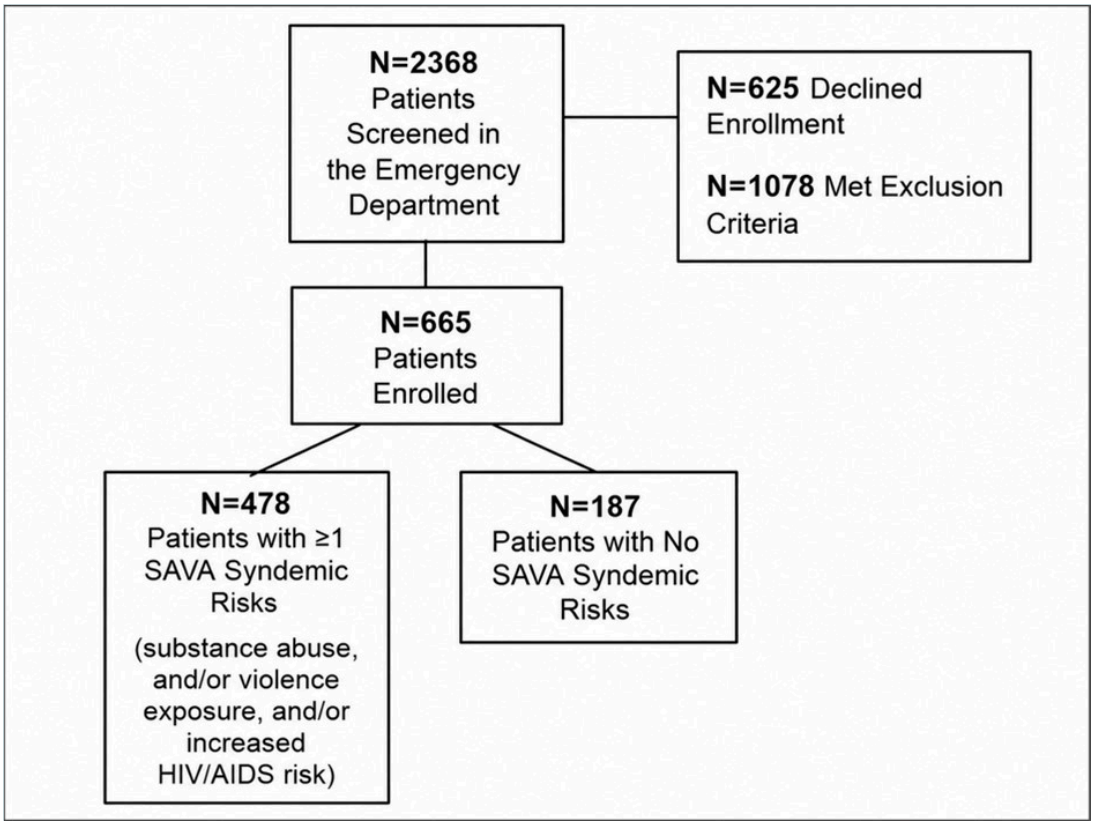


Figure 1. Patient Enrollment and SAVA Syndemic Risks

Table 1. Structural Equation Model Variables

	n (%)
HIV Risk	
Sexual Identity	
MSM	5 (0.8%)
Gay Man	4 (0.6%)
Know Sex Partner(s) HIV Status	
Yes	69 (10.4%)
No	596 (89.6%)
Past 6-months Consistent Condom Use	
Yes	383 (57.6%)
No	282 (42.4%)
Prior Injected Drug Use	
Yes	4 (0.6%)
No	661 (99.4%)

Table 1 (continued)

	n (%)
Commercial Sex Work	
Yes	9 (1.5%)
No	656 (98.6%)
HIV Testing Compliant	
Not tested	83 (12.7%)
Tested but not compliant	84 (12.8%)
Tested and compliant	489 (74.5%)
Substance Use Disorder risk	
Past 6-months Illicit Drug Use	
Yes	185 (27.8%)
No	480 (72.2%)
Drug use During Injury Event	
Yes	123 (18.5%)
No	542 (81.5%)
History of Poly-substance Use	
Yes	146 (22.0%)
No	519 (78.0%)
At risk for Hazardous Alcohol Use: Positive Alcohol Use Disorders Identification Test–Consumption	
Positive	162 (24.4%)
Negative	503 (75.6%)
Violence Risk	
Past 6-months Exposure to Physical Violence	
Yes	126 (18.9%)
No	539 (81.1%)
Past 6-months Exposure to Sexual Violence	
Yes	25 (3.8%)
No	640 (96.2%)
Past 6-months Exposure to Emotional Violence	
Yes	73 (11.0%)
No	592 (89.0%)

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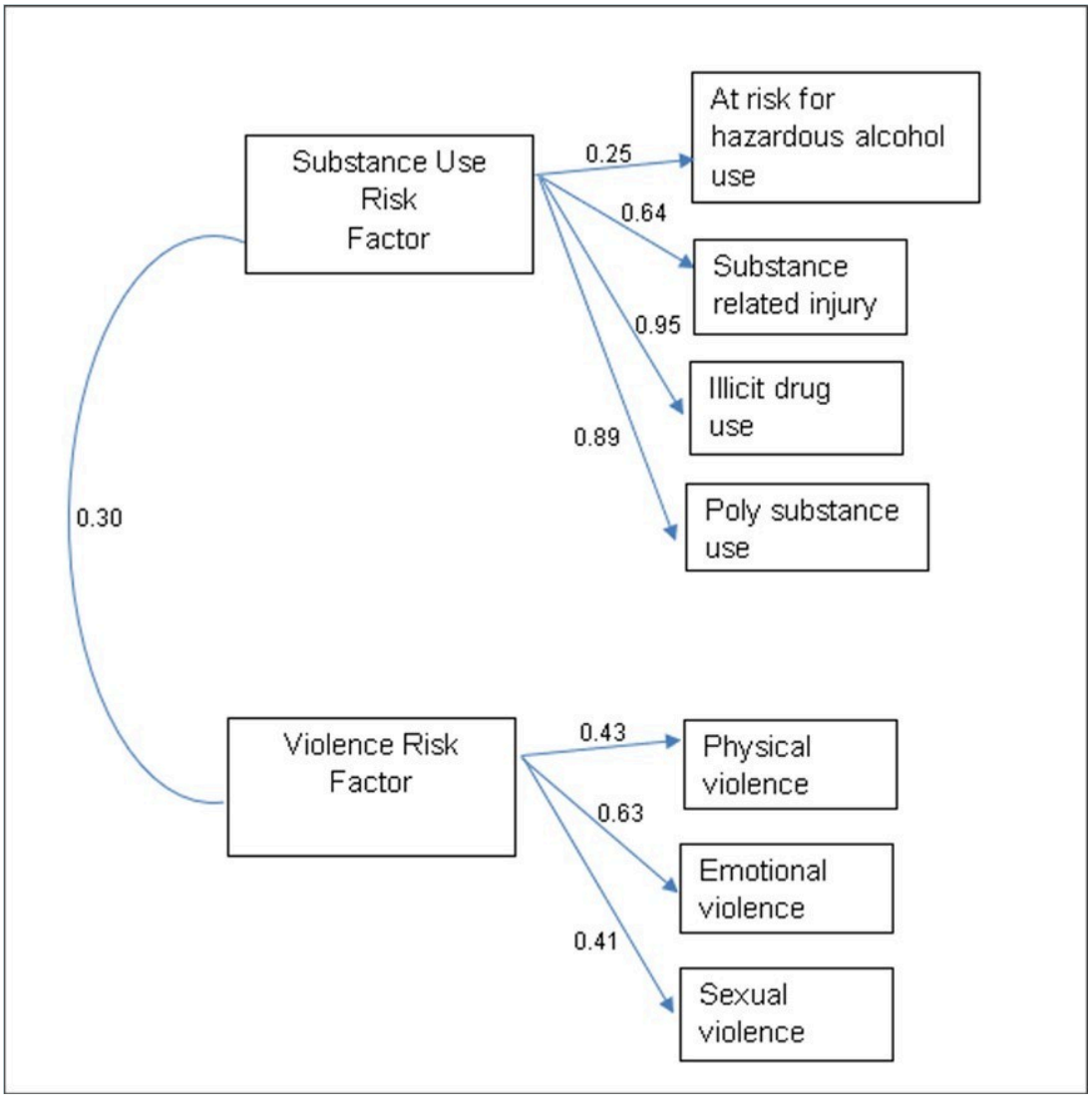
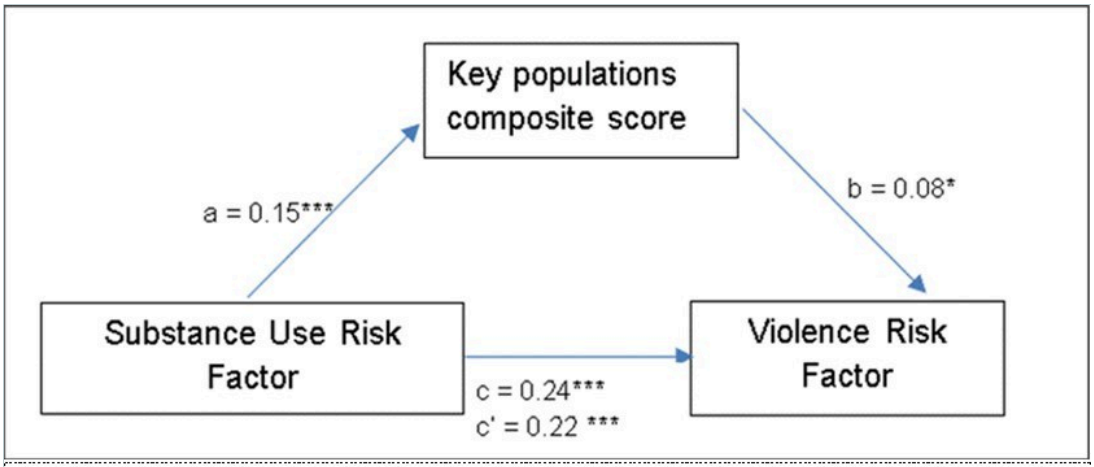


Figure 2. Structural Equation Model Two Factor Solution

Structural Equation Modeling Results

The exploratory and confirmatory SEM yielded two identified latent constructs that were supported by the overall fit indices and beta coefficients of the individual variables on the factor (Figure 2). The overall fit indices indicated a close fitting two-factor model (GFI=0.98, BB NFI=0.95, SRMR=0.04). The indicator variables had significant loadings on two of the three syndemic variables, substance use risk and violence exposure (ranging 0.25 to 0.95), but only MSM had a significant factor loading on the putative HIV risk factor, insufficient to determine that the latent factor had been identified. Additionally, violence exposure and substance use risk had significant and positive covariance (β=0.30, $p<0.001$).

Following the SEM, a mediation path analysis was conducted with the direct path between substance use risk and violence risk compared to a mediated pathway between substance use risk and violence risk when key populations were the mediating variable (Figure 3). Fit indices for this were within acceptable ranges (GFI=0.92, BB NFI=0.94, SRMR=0.05). Illustrated in Figure 3 the direct path between substance use risk is significant and positive in the direct path ($c=0.24$, $p<0.001$). The inclusion of the mediation variable, the key population composite HIV risk, partially mediated the relationship between substance use and violence. The direct path remained significant ($c'=0.22$, $p < 0.001$) and the indirect paths between substance use and key populations ($a=0.15$, $p < 0.001$) and key populations and violence risk ($b = 0.08$, $p < 0.05$) were also significant (Figure 3).



* p <0.05, *** p <0.001

Key populations: men who have sex with men, identify as gay, ever injecting drugs, and commercial sex worker

Figure 3. Mediation Model of Key Populations for HIV of Path between Substance Use Risk Factors and Violence Risk Factors
* p <0.05, *** p <0.001
Key populations: men who have sex with men, identify as gay, ever injecting drugs, and commercial sex worker

Discussion

In the current data a significant link was found between substance use and violence exposure which was mediated by the HIV risk. This advanced SEM analysis provides insight into the interplay of SAVA syndemic factors in the emergency care population from Kenya that has not been previously studied through a syndemic lens. The results can be used to inform development of programming to mitigate syndemic impacts in emergency care settings in Kenya and other similar settings. Given the nature of methods and context we propose that these findings are not a definitive framework for understanding all HIV-related SAVA relationships.

This study affirms prior research by highlighting the interplay between substance use, violence, and HIV, and advances the evidence to the never before studied population of emergency care patients in Kenya, in relation to SAVA syndemic understanding. [67] The high prevalence of violence, substance and HIV risk variables among the participants illustrates the potential role emergency care interactions could play in accessing persons affected by the syndemic burdens. Given the frequency of emergency care visitation in Africa, and the developing role that these care settings play in accessing and providing resources for higher-risk persons negatively affected by substance use, violence and HIV, research to leverage these interactions is needed. [42], [48], [49], [68], [69], [70] There is the potential to integrate interventions amidst existing emergency care and HIV testing services, even in a context that must deal with intermittent resource limitations. Given the early stage of this field of study, understanding of effective approaches for SAVA integrated screening, brief interventions and referral to treatment (SBIRT) programs would be informative and build on the prior works that have been done in these spaces. [51], [71], [72], [73], [74]

Distinct from previous work is the non-significant association between substance use or violence and HIV risk factors, which diverges from prior research in South Africa and Uganda where such associations were seen. [75], [76], [77] Other findings in sub-Saharan Africa have shown a correlation between violence and increased HIV risk. [78] This discrepancy may be due to differences in population characteristics, or the specific indicators of HIV risk utilized in this analysis. Notably, prior studies have largely focused on women, or youth, whereas this study centers on a largely male, injured, adult group that may exhibit distinctive patterns of syndemic interaction, which are important to understand in development of person-centered programming to address syndemic impacts. As illustrated in the

analysis, although the SEM did not fit all latent variables, the HIV risk was found to mediate the associated path between violence and substance use suggesting that the relationship is explained via the HIV risk variable for key populations. As there is a large body of literature demonstrating key population risks for violence victimization and substance use, as well as HIV, this relationship is congruent with the extant epidemiologic data. [69], [79], [80], [81] Given reaching persons from key populations is integral to achieving global HIV epidemic control, the current findings highlight how comprehensive services addressing syndemic disease may be an important component for key populations in emergency care settings.

Limitations

This study represents a significant step in understanding the SAVA syndemic in an ED context, yet several considerations should be made when interpreting the findings. This sample did not capture a number of potentially contributory risk factors such as mental health conditions, economic instability, or structural inequities among the injured patients included for analysis. HIV risk factors were limited to specific and somewhat heterogeneous indicators and may not have fully captured the entire spectrum of HIV vulnerabilities, particularly among a large urban population. Additionally, measures of substance use may not fully capture substance abuse in the population, although prior work has shown that screening for substance use can serve as a proxy for substance abuse. [82], [83] This study was based at a single urban ED site which may limit the ability to capture a broader set of SAVA exposures or cultural risk factors. The single site nature and study sample size limit generalizability. Future research could aim to better measure longitudinal outcomes, such as HIV treatment adherence, recurrence of violence, and substance use relapse, to better understand the syndemic's broader health impacts.

Conclusion

This study provides important insights into the synergistic challenges of substance use, HIV risk factors, and violence exposure among injured ED patients in Nairobi, Kenya. This study addressed a critical gap by focusing on an ED setting in Kenya, providing data from a high-burden, low-resource context often overlooked in the SAVA syndemic research. The analysis revealed a strong relationship between substance use and violence exposure, highlighting their mutual influence. However, the findings did not demonstrate significant associations between HIV risk factors and the other syndemic components, underscoring the complexity of these interactions within this population.

These results emphasize the need for targeted interventions during emergency care to address the intertwined issues of substance use and violence, particularly in locations where the burden of the SAVA syndemic is greatest. By leveraging advanced methodologies to better understand these dynamics, this study provides a framework for designing prevention strategies that address the root causes and overlapping impacts of these conditions in high-risk populations.

Competing Interests

The authors have no competing or financial interests to disclose.

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Declarations

Ethics approval

The study was approved by both the Kenyatta National Hospital (Nairobi, Kenya) Ethics and Research Committee and the Institutional Review Board of Rhode Island Hospital (Providence, RI, USA).

Consent

All participants provided informed consent, with study information and consents available in Kiswahili and English

Data, Materials and/or Code availability

The data that support the findings of this study are available from the corresponding author, JAL, upon reasonable request.

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