

Typologies of Conflict, Migration, and Sexual Health Risk among Female Sex Workers in Ukraine Post-Russian Invasion: A Latent Class Analysis

Marcela Lopez

marcela.lopez@uci.edu

University of California, Irvine

Cho-Hee Shrader

Rutgers, The State University of New Jersey

Pavlo Smyrnov

Alliance for Public Health

Daniel M. Parker

University of California, Irvine

Tetyana I. Vasylieva

University of California, Irvine

Research Article

Keywords: Internal Displacement, Sexual Health, HIV, Female Sex Workers, Latent Class Analysis

Posted Date: October 13th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11078270/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

TYPOLOGIES OF CONFLICT, MIGRATION, AND SEXUAL HEALTH RISK AMONG FEMALE SEX WORKERS IN UKRAINE POST-RUSSIAN INVASION: A LATENT CLASS ANALYSIS

Marcela Lopez¹, Cho-Hee Shrader², Pavlo Smyrnov³, Daniel M. Parker^{1,4}, Tetyana I. Vasylieva^{1,4}

1. Department of Epidemiology and Biostatistics, University of California, Irvine, California, USA
2. Division of Nursing Science, School of Nursing, Rutgers, The State University of New Jersey, Newark, New Jersey, USA
3. Alliance for Public Health, Kyiv, Ukraine
4. Department of Global Health and Biobehavioral Sciences, University of California, Irvine, California, USA

ABSTRACT

Background: In February 2022, the Russian government launched a full-scale invasion of Ukraine, displacing millions. To better understand how migration, conflict, and exposure to violence may have shaped risk perception and behaviors among female sex workers (FSWs) in Ukraine, we sought to typologize trends in migration trajectories and past experiences among relocated FSWs and to compare their sexual health behaviors and perceptions with those of non-relocated FSWs.

Methods: A peer-driven intervention conducted by the Alliance for Public Health interviewed individuals engaging in paid sex work in Ukraine, from September 2023 to January 2024. We conducted a latent class analysis to typologize groups of the interviewed women who had relocated since the Russian invasion based on shared migration experiences, histories of displacement, and past exposures to violence. We used logistic regression to compare post-invasion initiation into sex work, perceptions of sexual risk, and inconsistent condom use between our selected classes and non-relocated FSWs. We used negative binomial regression to compare their reported numbers of sexual partners.

Results: A total of 2,055 FSWs were interviewed. Two latent classes fit our data best: one defined as those who had experienced conflict related adversity (Class 1) and another based on personal adversity (Class 2). Compared to non-relocated FSWs, women in Class 1 had greater odds of not having engaged in sex work prior to the invasion (aOR: 14.00; 95% CI: 7.83-27.43), greater odds of reporting their sexual behavior becoming riskier since the invasion (aOR: 1.57; 95% CI: 1.13-2.18), decreased odds of inconsistent condom use (aOR: 0.54; 95% CI: 0.38-0.76), and more sexual partners (aRR: 1.14; 95% CI: 1.05-2.23); while women from Class 2 had increased odds of inconsistent condom use (aOR: 2.83; 95% CI: 1.72-4.66), and fewer sexual partners (aRR: 0.90; 95% CI: 0.82-0.99).

Conclusion: Factors that define the type of adversity experienced by relocated women, like the intensity of conflict in their former cities of residence or distance traveled, may be precursors to riskier sexual behavior. Self-reported displacement may not fully capture an individual's sexual risk profile. Interventions designed to minimize risks for women engaging in sex work should consider their individual migration histories.

(351 words)

KEYWORDS

Internal Displacement, Sexual Health, HIV, Female Sex Workers, Latent Class Analysis

ABBREVIATIONS

STIs – Sexually Transmitted Infections
FSWs – Female Sex Workers
IDP – Internally Displaced Person
PDI – Peer-Driven Intervention
SDEs – Standard Deviation Ellipses

INTRODUCTION

In February 2022, the Russian government launched a full-scale invasion of Ukraine, causing a nationwide humanitarian crisis. The United Nations Office of the High Commissioner for Human Rights reported that by July 2022, over 5,500 civilians had been killed and over 8,500 injured as a result of Russian military attacks [1]. The conflict has destroyed housing and public infrastructure, leaving millions internally displaced, with 3.7 million people displaced by the end of 2023 [2]. The most affected areas include the capital city of Kyiv, and eastern and southern cities such as Kharkiv, Mariupol, and Kherson, with most displaced populations moving westward [3].

Globally, armed conflicts increase the risk of HIV and other sexually transmitted infections (STIs), because of increased migration, displacement, and sexual violence, and decreased access to healthcare [4-7]. Furthermore, worsened economic conditions, increased military presence, and social destabilization caused by conflict can lead to worsened mental and physical health and coping with injection drug use [5,7,8]. Economic instability, housing insecurity, food shortages, and displacement also contribute to increased entry into sex work [5,7,9], while increased military presence increases the demand [9]. Furthermore, internally displaced individuals who resort to sex work because of war-related economic constraints may face increased pressure to engage in riskier sex, such as condomless sex, at reduced prices [10].

Since the early 2000s, Ukraine has had one of the highest reported adult HIV prevalences among European countries [11,12]. Despite the continued efforts by the Ukrainian governmental and non-governmental institutions to maintain access to HIV services [13,14], the Russian invasion has severely impacted the Ukraine's HIV prevention and treatment efforts [15,16]. The destruction of health infrastructure, economic instability, and displacement caused by the invasion raise concerns for increased HIV and STI transmission in Ukraine, especially for populations already at increased risk, such as female sex workers (FSWs) and their sexual partners [17]. Given that the majority of internally displaced Ukrainians are women (63%) [18], it necessitates investigation into how migration, economic instability, and entry into sex work have influenced women's sexual health behaviors and risk perception.

Among FSWs, older age, lower educational attainment, injection drug use, lifetime experiences of violence, and transient venues for soliciting clients (such as outdoors, along highways), have been identified as risk factors for HIV and other STIs [19,20]. Therefore, it is important to also consider how duration of engagement in sex work, education, drug use history, and past exposure to violence shape sexual health behaviors among FSWs in conflict-affected settings, including those in frontline and remote from combat areas.

Populations that have been forcibly displaced because of conflict might have different migration motivations and trajectories compared to economic migrants [21]. Forcibly displaced populations may have less time to relocate, fewer options for where to relocate, and grief or trauma from involuntarily leaving their homes, making it harder for them to find employment and acclimate in new areas. For economic migrants, economic opportunities might be the main deciding factor, thus relocation from rural to more urban areas is common [21]. Public health programs require displaced individuals to self-identify as being displaced to receive supportive services, but qualitative research has revealed reluctance among displaced populations in Eastern Ukraine to formally identify as an internally displaced person

(IDP) because of the bureaucratic and social consequences associated with the status, as well as displacement stigma [22].

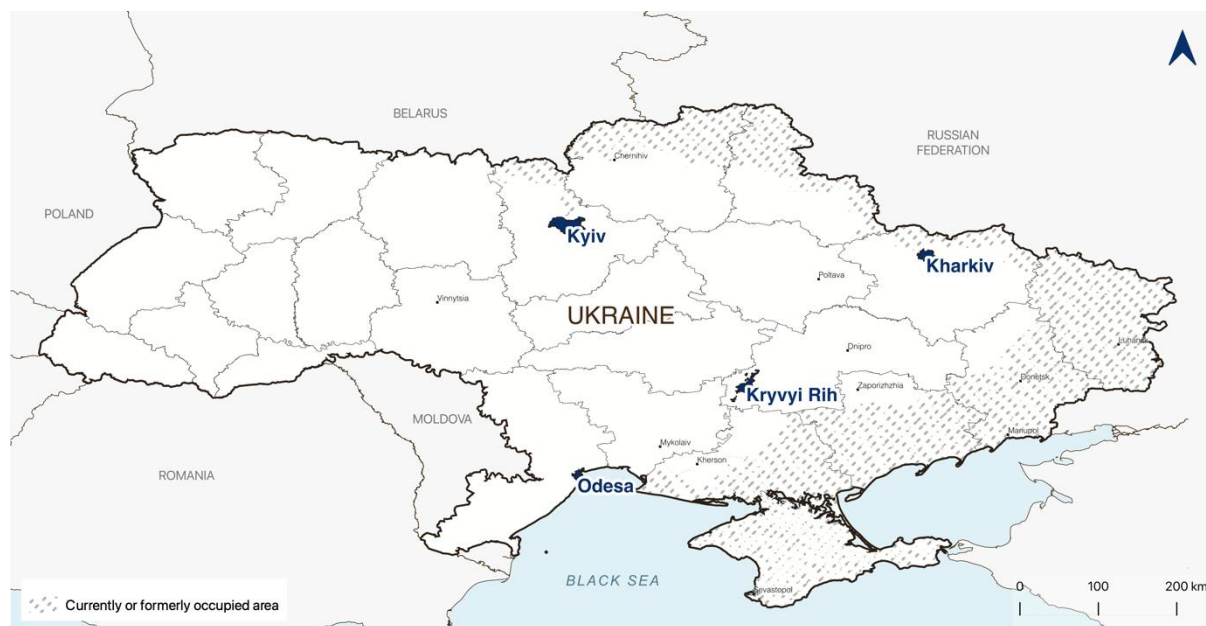
Given the potential reluctance to identify as an IDP, we sought to typologize trends in migration trajectories and past exposures to violence among relocated female sex workers in Ukraine, regardless of self-reported displacement status, using a latent class analysis approach. Latent class analysis has previously been used to identify shared characteristics and health risk profiles among women experiencing structural oppression and exposure to conflicts [23,24]. We similarly sought to identify groups of displaced or relocated FSWs in Ukraine based on shared migration trajectories and personal experiences and compare their post-migration sexual health risk behaviors and perceptions with those of FSWs who did not relocate. In doing so, we aimed to better understand how migration, conflict, and exposure to violence may have shaped HIV and STI risk perception and behaviors among FSWs.

METHODS

Data

A peer-driven intervention (PDI) conducted by the Alliance for Public Health in Ukraine interviewed individuals engaging in paid sex work in Kyiv, Kharkiv, Kryvyi Rih, and Odesa, Ukraine, between September 2023 to January 2024 (**Figure 1**) [25]. Kyiv, the capital, is the largest and most populous city in the country. Kharkiv is located in the frontline region in the east of the country and is the second-most populated city in Ukraine. Kryvyi Rih similarly neighbors the frontlines in south-eastern Ukraine and is the longest city in Europe. Odesa is a touristic city in southern Ukraine, on the Black Sea, and is the third-most populated city in the country.

Figure 1: Map of the Four Study Site Locations



The four major study cities in which the Alliance for Public Health conducted interviews with women engaging in paid sex work (Kyiv, Kharkiv, Kryvyi Rih, and Odesa) are denoted in dark blue.

The intervention used a modification of respondent-driven sampling to identify women aged 18 and older, who had provided sexual services in exchange for payment in the last six months, and who had either last received HIV prevention services from a harm reduction organization prior to July 1, 2022 or had never received HIV services before. Partner NGOs selected up to 8 seeds in each city, who were interviewed and connected to HIV prevention services. They were also asked to invite up to six of their peers meeting inclusion criteria into the study, following a respondent-driven sampling approach [26]. Interviewers asked about past and current sexual and injection drug-use behaviors, working conditions, healthcare access, and changes to interviewee's physical, mental, and sexual health since the Russian invasion in February 2022.

We obtained data on air strikes from 2022-2024 from the Violent Incident Information from News Articles on the 2022 Russian Invasion of Ukraine Repository (available at: <https://github.com/zhukovyuri/VIINA>) [27].

Outcomes of Interest

We examined four sexual health outcomes in our models: post-invasion entry into sex work, perceived change in sexual risk post-invasion, inconsistent condom use in the last 30 days, and number of sexual partners in the last 30 days.

We assessed post-invasion entry into sex work as a binary variable, based on self-reported responses of whether FSWs had engaged in sex work prior to the invasion, or started afterwards. Perceived change in sexual risk post-invasion was originally captured on a 3-point scale: whether FSWs reported they thought their sexual behavior had becoming safer, riskier, or remained unchanged following the Russian government's full-scale invasion on February 24, 2022. However, only a small number of participants (n=11) reported thinking their behavior had become safer. Therefore, we dichotomized this to "Safer or Unchanged" or "Riskier".

FSWs reported condom use history for vaginal, anal, and oral sex (always, in most cases, half of the time, sometimes, seldom, never, or not applicable). We transformed these responses into a binary variable, grouping together those who always used condoms and those who had not engaged in either vaginal or anal sex in the last 30 days, in contrast to participants who reported condom use less than 100% of time during vaginal or anal sex.

We calculated the total number of sexual partners FSWs had in the 30 days leading up to their interviews by summing the number of reported regular sexual partners, casual sexual partners, commercial sexual partners they paid for sex with, and commercial sexual partners that paid them for sex.

Variables of Interest

Interviewers collected information regarding housing stability, employment, educational attainment, exposure to physical and sexual violence, and preferred venues for seeking clients. We considered FSWs to be experiencing housing instability if their permanent place of residence in the last 90 days had been housing centers for internally displaced people, shelters, centers of social and psychological rehabilitation, orphanages, boarding schools, the streets, abandoned buildings, train or bus stations, or any random place available or if they reported being homeless, frequently moving from one residence to another, or spending nights at residence halls, hostels, train or bus stations in the last two years. We

grouped employment status into three categories: (1) full-time employment outside of sex work; (2) engaging in sex work full-time; or (3) other forms of employment, such as having part-time employment or attending school. We grouped educational attainment into three categories: (1) secondary education or below; (2) incomplete higher education, (3) complete higher education. We considered lifetime exposure to physical and sexually violence separately. Within each variable, we classified responses as “Experienced”, “Witnessed”, or “Never experienced”. Lastly, we grouped reported venues for finding clients into one of five domains: (1) transit or public spaces, such as parks or along highways; (2) recreational spaces, such as bars or brothels; (3) online or by phone; (4) through others in the sex work profession, such as pimps or other sex workers; (5) through other clients of theirs.

We identified FSWs who lived in a different city prior to February 24, 2022, and/or reported having been displaced after February 24, 2022, as having relocated. We calculated the haversine distance between the centroid coordinates for their prior and current cities of residence and dichotomized these distances at the median into “Short Distance” ($\leq 51\text{km}$) and “Long Distance” ($> 51\text{km}$). We measured past exposure to conflict by obtaining the total number of air strikes on their former cities of residence in 2022, as estimated by the Violent Incident Information from News Articles on the 2022 Russian Invasion of Ukraine Repository, and also dichotomized this variable using a median split (< 149 vs ≥ 149 strikes). We measured more recent exposure to conflict among all FSWs in the cohort by obtaining the total number of air strikes on their current cities of residence in the 30 days preceding their interviews.

Statistical Analyses

Exploratory Analysis

We characterized the distribution of our outcomes and variables of interest across our cohort by calculating the frequencies and proportions of FSWs in each level of our categorical variables, and the means, standard deviations, and medians for our continuous variables. We used chi-square tests and Cramér’s V correlation values to measure associations and correlations between our categorical variables prior to including them in our latent class analysis (**Supplemental Table 1**).

Latent Class Analysis

We conducted a series of 5 latent class analyses, composed of 2 to 6 groups, to typologize groups of women who had relocated since the Russian invasion based on shared migration experiences, histories of displacement, and past exposures to violence. Women who reported the same place of residence in 2022 as in the current study were not included in the latent class analysis. We included displacement status, experience living under Russian occupation, educational attainment, the intensity of air strikes in their former city of residence in 2022, distance relocated, and past experiences of physical and sexual assaults as indicator variables in our model. We used AIC and BIC to determine the best fitting number of classes and entropy to determine how well each model typologized participants into distinct groups. To avoid creating classes consisting of outliers, we excluded models with classes that contained less than 5% of participants [28]. Then, we assigned participants into classes for additional analyses.

Exploratory Spatial Data Analysis

We used standard deviation ellipses (SDEs) to measure and compare spatial patterns in places of origin among relocated FSWs. SDEs can be used to measure the central tendency, dispersion, and orientation

of geographic points across a landscape [29]. We used weighted SDEs to characterize the spatial distribution of relocated FSWs' former cities of residence and generated separate 1- and 2-standard-deviation ellipses for each class assignment and current city of residence. These ellipses are conventionally interpreted as encompassing approximately 68% and 95% of observations, respectively. Weighting accounted for multiple FSWs coming from the same locations, and our implementation replicated ArcGIS's Directional Distribution algorithm, which calculates variance using the total number of features [30].

Sexual Health Outcome Analyses

We used logistic regression to compare when FSWs started engaging in sex work – whether before or after the Russian invasion – between our selected classes and non-relocated FSWs, adjusting for age and current city of residence. We also used logistic regression to compare changes in perceptions of sexual risk since the Russian invasion between our selected classes and non-relocated FSWs, accounting for age, employment status, housing instability, venue for seeking clients, and drug use history.

To assess differences in sexual behavior at the time of their interviews, we used logistic regression to compare inconsistent condom use preceding their interviews between our selected classes and non-relocated FSWs, while accounting for age, employment status, housing instability, venue for seeking clients, drug use history, and the number of air strikes in their city in the last 30 days. We used negative binomial regression to compare the number of sexual partners FSWs reported having in the past 30 days between our selected classes and non-relocated FSWs, while similarly adjusting for age, employment status, housing instability, venue for seeking clients, drug use history, and the number of air strikes in their city in the last 30 days.

Software

We used QGIS version 3.26.3 (qgis.org) to create maps and the *SDEtool* (<https://github.com/parker-group/SDEtool>) to create SDEs. We conducted latent class analyses using the *poLCA* package in R statistical software version 4.3.1 and R Studio version 3.6.1. All other analyses were conducted using R statistical software and R Studio.

RESULTS

Study Population

A total of 2,055 FSWs were interviewed in this study, 473 (23.0%) of whom were from Kharkiv, 536 (26.1%) from Kryvyi Rih, 560 (27.3%) from Kyiv, and 486 (23.6%) from Odesa (**Table 1**). Participants reported a median age of 33.0 years (mean of 32.7 years (SD = 6.9)). Sex work was reported as the primary form of employment among 47.7% (of participants, while 11.5% reported full-time employment outside of sex work. Almost 41% of the cohort reported some other form of employment status, such as part-time employment, student, or housekeeping and other domestic activities. Educational attainment varied among FSWs, with 40.3% having completed a secondary education or less, 39.5% having completed a form of higher education (university or trade school), and 20.2% having received some higher education. Almost 28% of FSWs displayed some form of housing instability, such as having slept in a shelter, or housing center for internally displaced populations, or frequently changing their place of residence.

Furthermore, 6.1% FSWs reported being displaced after February 2022, while 8.8% did not report being displaced but reported a different place of residence prior to the invasion.

TABLE 1: Demographic Characteristics of Ukrainian FSWs Engaged in a Peer-Driven Intervention

CHARACTERISTIC	TOTAL (N=2,055)
City N(%)	
Kharkiv	473 (23.0%)
Kyiv	560 (27.3%)
Odesa	486 (23.6%)
Age	
Mean (SD)	32.7 (6.9)
Educational Attainment N(%)	
Secondary or Below	828 (40.3%)
Incomplete Higher Education	416 (20.2%)
Higher Education	811 (39.5%)
Employment Type N(%)	
Sex Work Only	981 (47.7%)
Permanent Position (Non-Sex Work)	237 (11.5%)
Other	837 (40.7%)
Housing Instability N(%)	
Yes	565 (27.5%)
No	1,490 (72.5%)
Injection Drug Use History N(%)	
Never	1,776 (86.4%)
Within the Last 30 Days	154 (7.5%)
Over 30 Days Ago	125 (6.1%)
Lifetime Experience of Physical Assault	
Never Experienced	1,408 (68.5%)
Witnessed	293 (14.3%)
Experienced	354 (17.2%)
Lifetime Experience of Sexual Assault	
Never Experienced	1,616 (78.6%)
Witnessed	68 (3.3%)
Experienced	371 (18.1%)

Demographic characteristics of Ukrainian female sex workers engaged in a peer-driven intervention from September 2023 to January 2024, n = 2,055

FSWs' perception of their sexual risk after the invasion differed, with 44.5% of participants perceiving their behavior as becoming riskier, and 55.5% reporting their behavior becoming safer or unchanged. The majority of FSWs engaged in sex work prior to the invasion, though 74 (3.6%) reported having not engaged in sex work before then.

The number of sexual partners reported in the last 30 days ranged from 3 to 170 partners, with a median of 28 and a mean of 33.9 (SD = 21.9). FSWs most commonly sought clients through others in the sex work profession (i.e., pimps or other sex workers, 618 (30.1%)), followed by through other clients, online or by phone, recreational spaces (i.e., bars or brothels), and transit centers or other public spaces. Almost 46% of FSWs (N = 940) had engaged in vaginal and/or anal sex without a condom in the past 30 days.

Latent Classes

We fit latent class models with 2 to 6 classes (**Supplemental Table 2**). Based on an elbow test of AIC and BIC, we concluded that two classes best fit our data (**Supplemental Figure 1**). Posterior probabilities of responses for each indicator variable are in **Supplemental Figure 2**. After modal class assignment, (assigning individuals to the class for which they had highest posterior probability), Class 1 consisted of 182 relocated FSWs (59.7%) and Class 2 of 123 relocated FSWs (40.3%). Class 1, titled “Conflict-Related Adversity”, consisted primarily of FSWs who self-reported as displaced and those who reported living under Russian occupation. They relocated further distances, from areas most affected by air strikes. Class 2, the “Personal-Related Adversity” group, consisted of short-distance migrants who did not report being displaced, with lower educational attainment, and greater experiences of physical and sexual violence. Details on class characteristics can be found in **Figure 2, Table 2**, and **Table 3**.

Figure 2: Distribution of Relocated FSWs’ Responses to Indicator Variables of Interest, Based on Class Assignment

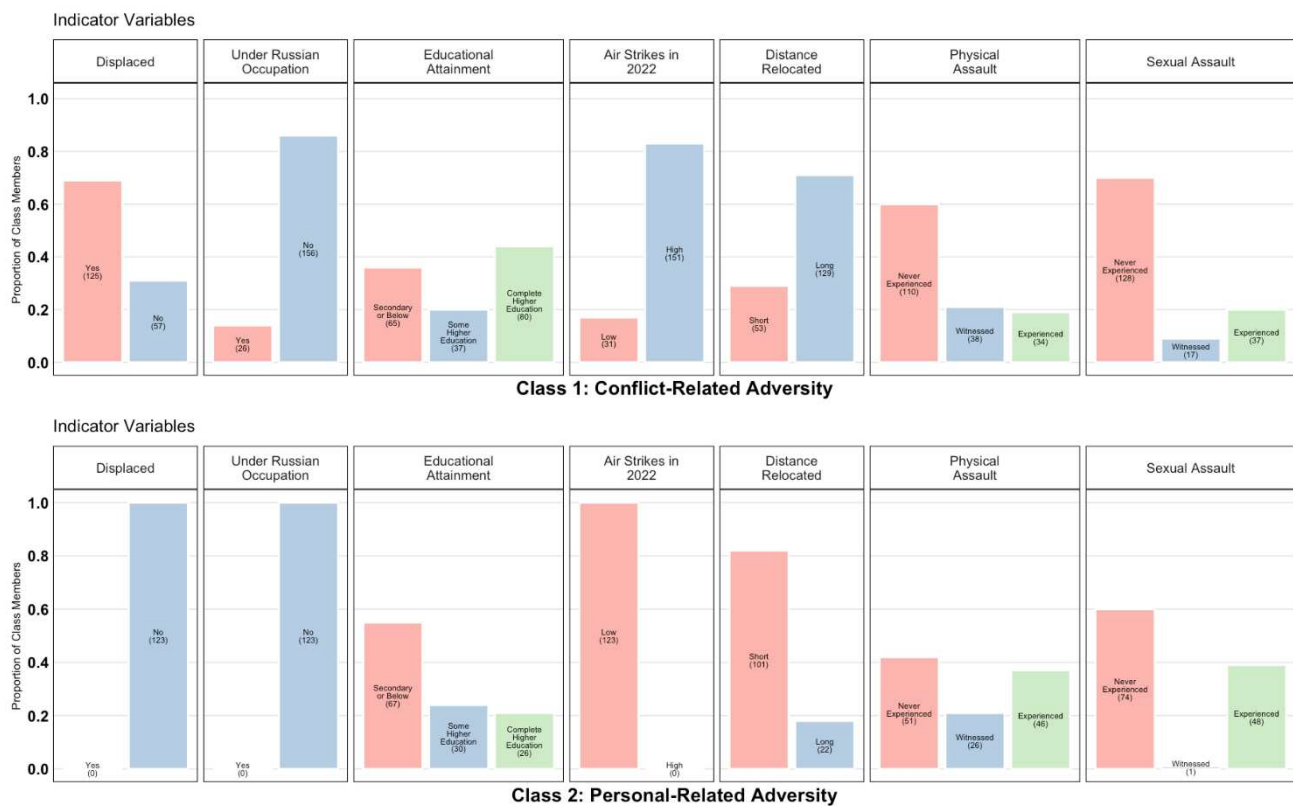


TABLE 2: Migration Experiences, Histories of Displacement, and Past-Exposures to Violence among Relocated FSWs by Class Assignment

CHARACTERISTIC	CLASS 1 Conflict-Related Adversity (N=182)	CLASS 2 Personal-Related Adversity (N=123)	TOTAL (N=305)
Displaced after February 2022			
Yes	125 (68.7%)	0 (0.0%)	125 (41.0%)
No	57 (31.3%)	123 (100.0%)	180 (59.0%)
Ever Lived Under Russian Occupation			
Yes	26 (14.3%)	0 (0.0%)	26 (8.5%)
No	156 (85.7%)	123 (100.0%)	249 (91.5%)
Educational Attainment N(%)			
Secondary or Below	65 (35.7%)	67 (54.5%)	132 (43.3%)
Incomplete Higher Education	37 (20.3%)	30 (24.4%)	67 (22.0%)
Higher Education	80 (44.0%)	26 (21.1%)	106 (34.8%)
Air Strikes in Former City of Residence in 2022			
Higher volume (≥ 149 strikes)	151 (83.0%)	0 (0.0%)	151 (49.5%)
Lower volume (< 149 strikes)	31 (17.0%)	123 (100.0%)	154 (50.5%)
Distance Relocated			
Longer Distance (> 51 km)	129 (70.9%)	22 (17.9%)	151 (49.5%)
Shorter Distance (≤ 51 km)	53 (29.1%)	101 (82.1%)	154 (50.5%)
Lifetime Experience of Physical Assault			
Never Experienced	110 (60.4%)	51 (41.5%)	161 (52.8%)
Witnessed	38 (20.9%)	26 (21.1%)	64 (21.0%)
Experienced	34 (18.7%)	46 (37.4%)	80 (26.2%)
Lifetime Experience of Sexual Assault			
Never Experienced	128 (70.3%)	74 (60.2%)	202 (66.2%)
Witnessed	17 (9.3%)	1 (0.8%)	18 (5.9%)
Experienced	37 (20.3%)	48 (39.0%)	85 (27.9%)

All p-values < 0.001

Migration experiences, histories of displacement, and past-exposures to violence for relocated female sex workers in Ukraine post-Russian invasion, divided by latent class assignment, n = 305

TABLE 3: Characteristics and Outcomes of Interest among Relocated and Non-Relocated FSWs by Class Assignment

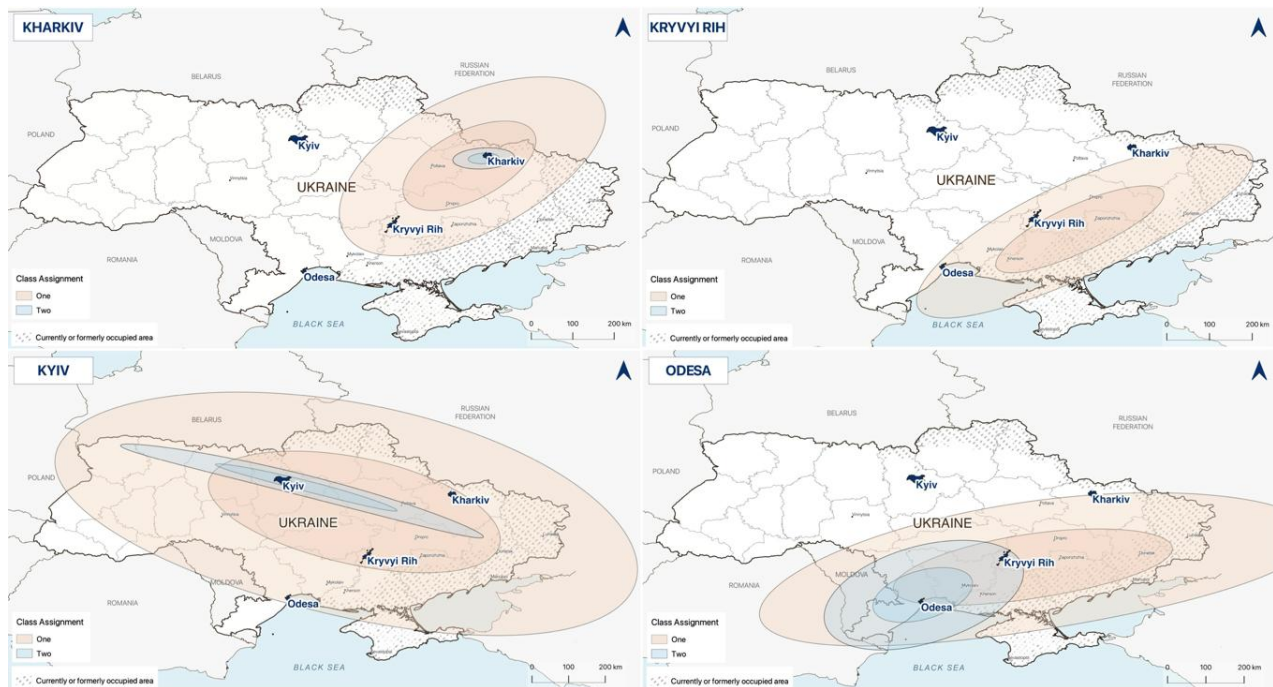
CHARACTERISTIC	NON-RELOCATED (N=1,750)	CLASS 1 (N=182)	CLASS 2 (N=123)	TOTAL (N=2,055)
City				
Kharkiv	392 (22.4%)	63 (34.6%)	18 (14.6%)	473 (23.0%)
Kyiv	524 (29.9%)	12 (6.6%)	0 (0.0%)	536 (26.1%)
Odesa	457 (26.1%)	84 (46.2%)	19 (15.4%)	560 (27.3%)
Other	377 (21.5%)	23 (12.6%)	86 (69.9%)	486 (23.6%)
Employment Type N(%)				
Sex Work Only	813 (46.5%)	88 (48.4%)	80 (65.0%)	981 (47.7%)
Permanent Position (Non-Sex Work)	226 (12.9%)	10 (5.5%)	1 (0.8%)	237 (11.5%)
Other	711 (40.6%)	84 (46.2%)	42 (34.1%)	837 (40.7%)
Venue for Finding Clients N(%)				
Transit/Public Spaces	114 (6.5%)	6 (3.3%)	2 (1.6%)	122 (5.9%)
Recreational Spaces	239 (13.7%)	6 (3.3%)	1 (0.8%)	246 (12.0%)
Online or By Phone	473 (27.0%)	52 (28.6%)	9 (7.3%)	534 (26.0%)
Through Others in the Sex Work Profession	509 (29.1%)	50 (27.5%)	59 (48.0%)	618 (30.1%)
Through Other Clients	415 (23.7%)	68 (37.4%)	52 (42.3%)	535 (26.0%)
Housing Instability N(%)				
Yes	398 (22.7%)	103 (56.6%)	64 (52.0%)	565 (27.5%)
No	1,352 (77.3%)	79 (43.4%)	59 (48.0%)	1,490 (72.5%)
Injection Drug Use History N(%)				
Never	1,522 (87.0%)	161 (88.5%)	93 (75.6%)	1,776 (86.4%)
Within the Last 30 Days	136 (7.8%)	8 (4.4%)	10 (8.1%)	154 (7.5%)
Over 30 Days Ago	92 (5.3%)	13 (7.1%)	20 (16.3%)	125 (6.1%)
Age				
Mean (SD)	32.8 (6.9)	32.1 (7.2)	31.1 (6.2)	32.7 (6.9)
Total Number of Air Strikes in the Last 30 Days				
Mean (SD)	34.6 (16.1)	35.2 (19.3)	40.5 (18.9)	35.0 (16.6)
Inconsistent Condom Use in the Last 30 Days N(%)				
Yes	769 (43.9%)	71 (39.0%)	100 (81.3%)	940 (45.7%)
No	981 (56.1%)	111 (61.0%)	23 (18.7%)	1,115 (54.3%)
Total Number of Sexual Partners in the Last 30 Days				
Mean (SD)	33.6 (21.6)	38.1 (26.7)	32.4 (17.5)	33.9 (21.9)
Perception of Sexual Risk After the Russian Invasion N(%)				
Safer or No Change	964 (57.1%)	74 (41.8%)	65 (53.7%)	1,103 (55.5%)
Riskier	725 (42.9%)	103 (58.2%)	56 (46.3%)	884 (44.5%)
Missing	61	5	2	68
Started Engaging in Sex Work After the Russian Invasion N(%)				
Yes	38 (2.2%)	29 (15.9%)	7 (5.7%)	74 (3.6%)
No	1,712 (97.8%)	153 (84.1%)	116 (94.3%)	1,981 (96.4%)

Characteristics and outcomes of interest among relocated and non-relocated female sex workers in Ukraine post-Russian invasion, divided by latent class assignment

Geographic Distribution of Relocation

There was considerable geographic variation in relocated FSWs' prior city of residence (**Figure 3**). Among all four study sites, locations centered around FSWs' current cities of residence. Apart from FSWs now living in Kyiv, most relocated FSWs moved westward from conflict-affected areas, as indicated by the elongated ellipses covering the eastern and southern regions of Ukraine. However, FSWs in Class 1 had greater dispersion in their prior cities of residence (as depicted by wider, orange ellipses), while in Class 2's prior cities of residence clustered closer to their mean centers (blue ellipses). This suggests that conflict-affected FSWs (Class 1) traveled from further away, from a broader spread of locations, primarily in the eastern half of the country. Conversely, the former cities of residence for FSWs in Class 2 now living in Kharkiv were mostly concentrated in the greater Kharkiv region. Of note, all relocated FSWs now living in Kryvyi Rih were assigned to Class 1. Furthermore, unlike the other three cities in our study, the first standard deviation ellipse for FSWs now living in Kryvyi Rih centered just east of the city, an observation likely driven by the city's unusually long shape. Individuals' former cities of residence within each ellipse are mapped in **Supplemental Figures 3-6**. Exact percentages of points captured within each SDE are **Supplemental Table 3**.

Figure 3: Standard Deviation Ellipses for Relocated FSWs' Former City of Residence



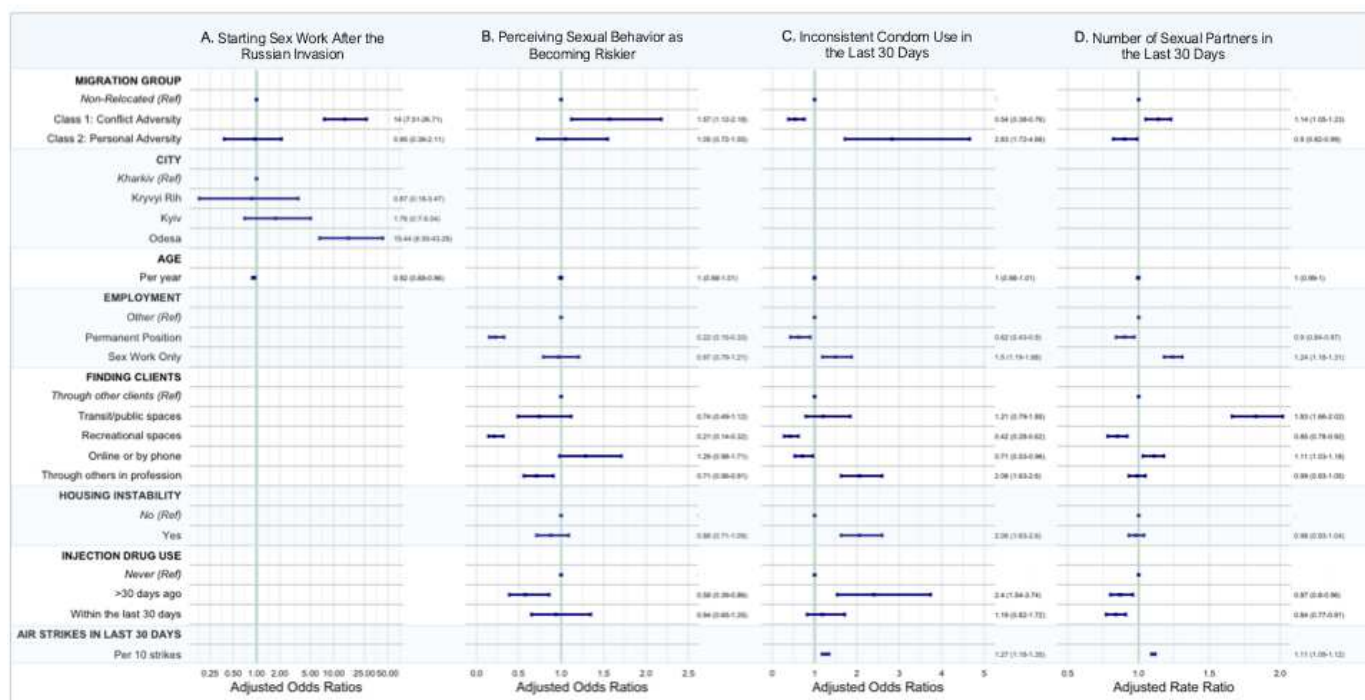
Standard Deviation Ellipses (SDEs) for the distribution of relocated FSWs' city of residence prior to the Russian Invasion in February 2022, grouped by their current city of residence

Sexual Health Outcomes

Starting Sex Work After the Russian Invasion

FSWs in Class 1 had 14 times greater odds of not having engaged in sex work prior to February 2022, only starting after the invasion, even after adjusting for age and city (95% CI: 7.83-27.43) (**Figure 4A and Supplemental Table 4**). Furthermore, all FSWs living in Odesa also had significantly greater odds of entering sex work after the Russian invasion.

Figure 4: Estimated Adjusted Odds Ratios with 95% CIs from Sexual Health Outcome Regressions



A. Adjusted odds of Ukrainian female sex workers starting sex work after the Russian Invasion; **B.** Adjusted odds of perceiving sexual behavior as having become riskier among Ukrainian female sex workers post-Russian invasion; **C.** Adjusted odds of inconsistent condom use in the last 30 Days among female sex workers in Ukraine; **D.** Adjusted rate ratios for the number of sexual partners in the last 30 days among female sex workers in Ukraine

Perceiving Sexual Behavior as Becoming Riskier

Compared to non-relocated FSWs, FSWs from Class 1 had 57% greater odds of reporting their sexual behavior becoming riskier since the Russian invasion (aOR: 1.57; 95% CI: 1.13-2.18), after accounting for age, employment status, venue for finding clients, housing instability, and injection drug use history (**Figure 4B**). Those in Class 2 did not significantly differ from non-relocated FSWs.

FSWs with full-time employment or who primarily found clients in recreational spaces or through others in the profession had lower odds of perceiving their sexual behavior as becoming riskier since the invasion, compared to FSWs who primarily found their clients through other clients. Those who had a history of injection use drug, but who had not used them in the past 30 days, had 42% lower odds of

perceiving their sexual behavior as having become riskier (aOR: 0.58; 95% CI: 0.39-0.86), compared to those who had never injected drugs.

Inconsistent Condom Use

Compared to non-relocated FSWs, FSWs from Class 2 had 2.83 times increased odds of inconsistent condom use in the 30 days prior to being interviewed (95% CI: 1.72-4.66), even after accounting for age, education, employment, venue for finding clients, housing instability, injection drug use history, and number of air strikes in their city in last 30 days (**Figure 4C**). FSWs in Class 1, however, had 46% decreased odds of inconsistent condom use (aOR: 0.54; 95% CI: 0.38-0.76). Only engaging in sex work for employment was also associated with 50% increased odds of inconsistent condom use, compared to other forms of employment (aOR: 1.50; 95% CI: 1.19-1.88). Odds also differed by where FSWs found their clients, with those finding clients through others in the profession (i.e., other sex workers or pimps) having over twice the odds of inconsistent condom use (aOR: 2.06; 95% CI: 1.59-2.67), compared to those who found clients through other clients of theirs. Housing instability, past (but not current) injection drug use, and increased air strikes in their city in the last month were also associated increased odds of inconsistent condom use.

Number of Sexual Partner

FSWs in Class 1 on average had more sexual partners in the last 30 days than non-relocated FSWs (**Figure 4D**). However, FSWs in Class 2 had statistically significantly fewer sexual partners in the last 30 days. Those who engaged in sex work as their only form of employment and those who found clients in transit or public spaces had the highest numbers of sexual partners on average.

DISCUSSION

We typologized classes of FSW based on their distinct experiences of adversity and violence and characterized differences in their HIV-related risk behaviors. Our latent class analysis identified 57 FSWs who did not self-report as having been displaced, but who had similar experiences as those who did identify as displaced, as evidenced by their placement into Class 1. Our findings suggest that self-identification may not be enough to identify individuals who may benefit from targeted interventions for displaced populations. Factors like the intensity of conflict in their former city of residence or the distance between someone's current and former cities of residence may be precursors to riskier sexual behavior.

We found that displaced and relocated FSWs who were exposed to conflict (Class 1) both had higher odds of entering in sex work after the invasion and, possibly consequently, perceived their sexual behavior as becoming riskier since onset of war. Prior studies have similarly identified increased entry into sex work in conflict-affected settings [9, 10]. Conflict-affected FSWs in our study also reported more sexual partners in the past month compared to FSWs who did not relocate. Unlike economic migrants, who can plan and financially prepare to relocate to a predetermined area, conflict-affected migrants have less choice in where they relocate, prioritizing immediate safety over other factors like ideological, social, or professional fit in their new area [21]. Because of the unpredictability and urgency associated with conflict-related migration, conflict-affected FSWs may face difficulties finding employment or

assimilating into their new communities [21]. Difficulties finding employment in an area where they may lack professional ties may be a reason for why FSWs in Class 1 reported more sexual partners compared to non-relocated FSWs, and why they initiated sex work post-invasion.

At the same time, FSWs in this class also had lower odds of inconsistent condom use within the same period. Research suggests that FSWs are less likely to use condoms over time with regular clients as compared to non-regular clients, likely due to increased familiarity and trust [31, 32, 33]. FSWs in Class 1 may have not had enough time to develop this kind of familiarity with clients, and an overall lack of familiarity with their new area may have heightened their sense of risk. Therefore, we believe that recent migration, more recent entry into sex work, and a perception of increased risk may have influenced higher condom use among FSWs in this group.

FSWs in Class 2 were more likely to have migrated shorter distances and had lower educational attainment. We suspect their migration may have been in part due to post-invasion economic instability, as they primarily relocated closer to urban centers, from more rural outer regions. Lower educational attainment and economic pressures have previously been identified as risk factors for inconsistent condom use among FSWs [19, 20, 34]. In our cohort, FSWs in Class 2 had greater odds of inconsistent condom use, possibly due to economic pressures to engage in riskier behavior. FSWs in Class 2 and non-relocated FSWs had similar rates of post-invasion entry into sex work, with the majority of FSWs in both groups starting prior to the invasion. Similar rates of pre-invasion sex work experiences may be a reason for why these two groups did not differ in their perceptions of their sexual risk post-invasion.

FSWs engaging in sex work as their main form of employment had more sexual partners on average and greater odds of inconsistent condom use. These findings may have both been motivated by economic pressure, as FSWs in eastern Ukraine interviewed in 2018 expressed concerns over conflict-related inflation, needing to take on larger client loads or work in more precarious settings to maintain their current incomes [35]. Likewise, FSWs facing insecure housing conditions may have similarly felt pressure to engage in riskier sex practices.

FSWs who found clients through others in their profession had greater odds of inconsistent condom use. As mentioned, condom use is likely to decrease with increased familiarity and trust [31, 32, 33]. We suspect that inconsistent condom use within this group may have been due to a sense of safety and familiarity with these referred clients.

Past injection drug use was associated with decreased odds of perceiving their sexual behavior as becoming riskier. We suspect that they may have been engaging in riskier sexual behaviors prior to the invasion, such as using injection drugs while engaging in sex work. Therefore, relative to past sexual experiences, their behaviors at the time of being interviewed would be perceived as safer. Research on sexual risk among FSWs in the Russian Federation found that women who used to inject drugs had similar condom use and sexual risk outcomes compared to women who had never injected drugs [36]. However, we did not see this within our cohort, as FSWs who used to inject drugs had increased odds of inconsistent condom use and more sexual partners on average.

FSWs experiences differed based on their primary venue for seeking clients. For example, FSW who primarily sought clients in transit/public spaces had the greatest average number of sexual partners, compared to FSWs who primarily sought clients in other venues. Research involving FSWs in eastern

Ukraine working in these settings showed that they were more likely to have clients in the military and to experience physical and sexual violence perpetrated by sexual partners [37]. Our findings similarly highlight workplace-specific differences in sexual risk among FSWs in Ukraine.

Our results also reflect differences between each of the four study sites. FSWs who relocated to Odesa had significantly greater odds of entering sex work after the onset of the invasion compared to the other cities in our study. Odesa is a coastal city and a popular destination for tourism, including international sexual tourism [38]. Tourist-driven demand for sex work may have been a motivating factor for initiation into sex work among women who relocated there. Meanwhile, migrants to Kryvyi Rih predominantly originated from conflict-affected areas, including currently or formerly occupied areas. These migrants all had greater probabilities of being assigned to Class 1 relative to Class 2. Kyiv received relocated women from all over the country, suggesting that migration there may be motivated by factors other than fleeing from conflict. Differences in the political and economic landscapes of receiving cities may be shaping women's sexual health risk.

We acknowledge that one of the limitations of our analysis is that it is based on a cross-sectional study of self-reported data, limiting our ability to infer strong causal associations. Recall bias of participants' experiences prior to February 2022 might also be a concern as they were interviewed between late-2023 and early-2024. We are also not sure what migration paths participants took, and what intermediary locations they may have resided in, between their 2022 and current location. Moreover, it is possible we misclassified participant who relocated after February 2022 but moved back to their original place of residence by the time of participation in this study as having not relocated. Small sample sizes also prevented us from being able to run a multi-level latent class analysis. After running our latent class analyses, we did not adjust for misclassification bias when conducting the regressions. Therefore, regression results may be underestimated. Furthermore, air strike data were estimated from news reporting, and do not include strikes that were not reported.

We also would like to stress that condom use is not entirely voluntary nor solely driven by FSWs. For example, structural and financial barriers can hinder condom use. Almost half of all FSWs interviewed had engaged in condomless vaginal or anal sex in the past 30 days. The destruction of health infrastructure may make it even more difficult for FSWs to access free condoms. Furthermore, factors like power imbalances, coercion, and threats of violence can shift condom-use decision-making power over to clients [39,40]. Further research should explore condom negotiation and client resistance to condom use, and future interventions should aim to improve negotiation power among FSWs and address the structural, financial, and interpersonal barriers limiting condom access and use.

Despite the limitations, our study brings insight from a large cohort of women from four major cities in Ukraine, with varying degrees of personal and conflict-related adversities. Interviews specifically captured pre- and post-invasion perspectives, explicitly asking about changes since the invasion. Such data on a known, but understudied problem are rarely collected. We integrated conflict data and leveraged latent class analysis to identify two groups of migrant FSWs with shared backgrounds and compared their sexual health perception and behaviors with FSWs who had not relocated. Our latent class analysis identified participants who did not identify as having been displaced, but who had similar backgrounds and past experiences as those who did. We used the findings from our latent class analysis to conduct a spatial analysis and regressions, map migration patterns, and uncover similarities among

those in each migration class. Importantly, such analyses can be applied in other humanitarian aid settings to identify at-risk groups who may not identify as displaced due to the perceived voluntariness of their migration, but who share similar migration trajectories and past exposure to violence.

Conclusion

Harm reduction strategies that improve economic conditions for women relocating from conflict-affected areas may decrease their reliance on sex work for income or prevent their initiation into sex work. Self-reported displacement may not fully capture someone's sexual risk profile. HIV and STI prevention strategies should also aim to address gender-based violence and improve negotiation power for sex workers. Understanding differences in sexual risk behaviors based on or related to migration trajectories, as well as the motivations driving them, could inform future HIV prevention interventions in countries experiencing conflict-related internal displacement.

DECLARATIONS

Ethics Approval and Consent to Participate

This secondary data analysis was determined non-human subjects research under protocol #7199 by UC Irvine IRB. All participants signed written informed consent at the time of their participation in PDI.

Consent for Publication

Not Applicable

Availability of Data and Materials

Air strike data used in this study are available in the VIINA 2.0: Violent Incident Information from News Articles repository at <https://github.com/zhukovyuri/VIINA>. Interview data may be obtained from the Alliance for Public Health upon reasonable request.

Competing Interests

The authors declare that they have no competing interests.

Funding

This work was supported by NIH NIDA R01DA057141 grant.

Author Contributions

ML and TIV conceptualized the research question. ML, DMP, and TIV designed the analyses. ML performed the analyses and created all tables and figures; CHS consulted on latent class analysis. ML drafted the manuscript; all other authors edited the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We would like to thank the participants for their time and the NGOs, Alliance for Public Health in Ukraine, The Blago Foundation, Convictus Ukraine, Obschdorovye, and Vira, Nadiia, Lyubov, for their involvement with this project.

REFERENCES

- [1] UN Office of the High Commissioner for Human Rights. Ukraine: civilian casualty update 25 July 2022 [Internet]. United Nations; 2022. [cited 2026 Apr 17]. Available from: <https://ohchr.org>.
- [2] Internal Displacement Monitoring Centre. Ukraine [Internet]. Internal Displacement Monitoring Centre; 2024. [cited 2026 Apr 17]. Available from: <https://internal-displacement.org>.
- [3] Albrecht C, Panchenko T. Refugee flow from Ukraine: Origins, effects, scales and consequences. In: CESifo Forum. vol. 23. München: ifo Institut-Leibniz-Institut für Wirtschaftsforschung an der . . . ; 2022. p. 8-16.
- [4] Sundaram M, Filion A, Akaribo BE, Stephens PR. Footprint of war: integrating armed conflicts in disease ecology. *Trends in parasitology*. 2023;39(4):238-41.
- [5] Kvasnevskaya Y, Faustova M, Voronova K, Basarab Y, Lopatina Y. Impact of war-associated factors on spread of sexually transmitted infections: a systemic review. *Frontiers in public health*. 2024;12:1366600.
- [6] Spiegel PB. HIV/AIDS among conflict-affected and displaced populations: Dispelling myths and taking action. *Disasters*. 2004;28(3):322-39.
- [7] Friedman SR, Rossi D, Perlman DC. Historical and theoretical roots of the big events framework. *International Journal of Drug Policy*. 2024;133:104606.
- [8] Bendavid E, Boerma T, Akseer N, Langer A, Malembaka EB, Okiro EA, et al. The effects of armed conflict on the health of women and children. *The Lancet*. 2021;397(10273):522-32.
- [9] Hynes HP. On the battlefield of women's bodies: An overview of the harm of war to women. In: *Women's Studies International Forum*. vol. 27. Elsevier; 2004. p. 431-45.
- [10] Ferguson A, Shannon K, Butler J, Goldenberg SM. A comprehensive review of HIV/STI prevention and sexual and reproductive health services among sex Workers in Conflict-Affected Settings: call for an evidence-and rights-based approach in the humanitarian response. *Conflict and health*. 2017;11(1):25.
- [11] Kruglov Y, Kobyshcha Y, Salyuk T, Varetska O, Shakarishvili A, Saldanha V. The most severe HIV epidemic in Europe: Ukraine's national HIV prevalence estimates for 2007. *Sexually transmitted infections*. 2008;84(Suppl 1):i37-41.
- [12] European Centre for Disease Prevention and Control, WHO Regional Office for Europe. HIV/AIDS surveillance in Europe 2025 – 2024 data. Stockholm and Copenhagen: European Centre for Disease Prevention and Control; 2025. Available from: <https://www.ecdc.europa.eu/en/publications-data/hivaids-surveillance-europe-2025-2024-data>.
- [13] Barsukova A, Shvab M, Puttkammer NH, Vitruk O, Ihnatiuk AP, Hetman LI, et al. Impact of war on HIV-related healthcare services and health workers in eastern Ukraine: a qualitative study. *AIDS care*. 2024;36(9):1213-21.
- [14] Ivasiy R, Galvez de Leon SJ, Meteliuk A, Fomenko T, Pykalo I, Bromberg DJ, et al. Responding to health policy recommendations on managing opioid use disorder during Russia's invasion of Ukraine: divergent responses from the frontline to the west. *Frontiers in Public Health*. 2023;10:1044677.

- [15] Nikitin BM, Bromberg DJ, Pykalo I, Ivasiy R, Islam Z, Altice FL. Early disruptions to syringe services programs during the Russian invasion of Ukraine. *Frontiers in Public Health*. 2023;11:1229057.
- [16] Parczewski M, Gökengin D, Sullivan A, de Amo J, Cairns G, Bivol S, et al.. Control of HIV across the WHO European region: progress and remaining challenges. *Lancet Reg Health Eur*. 2025; 52: 101243;.
- [17] Friedman SR, Smyrnov P, Vasylyeva TI. Will the Russian war in Ukraine unleash larger epidemics of HIV, TB and associated conditions and diseases in Ukraine? *Harm reduction journal*. 2023;20(1):119.
- [18] United Nations Office for the Coordination of Humanitarian Affairs, United Nations High Commissioner for Refugees. Ukraine: Summary of the Humanitarian Needs and Response Plan and the Regional Refugee Response Plan. Geneva; 2025. Available from: <https://www.unocha.org/publications/report/ukraine/ukraine-summary-humanitarian-needs-and-response-plan-and-regional-refugee-response-plan-january-202>
- [19] Iakunchykova OP, Burlaka V. Correlates of HIV and inconsistent condom use among female sex workers in Ukraine. *AIDS and Behavior*. 2017;21(8):2306-15.
- [20] Tokar A, Sazonova I, Mishra S, Smyrnov P, Saliuk T, Lazarus JV, et al. HIV testing behaviour and HIV prevalence among female sex workers in Ukraine: findings from an Integrated Bio-Behavioural Survey, 2013–2014. *Sexually Transmitted Infections*. 2019;95(3):193-200.
- [21] Voznyak H, Mulska O, Druhov O, Patytska K, Tymechko I. Internal migration during the war in Ukraine: Recent challenges and problems. *Problems and Perspectives in Management*. 2023;21(1):312.
- [22] Tarkhanova O. Shades of protracted displacement: reconciling citizenship and the status of internally displaced in Eastern Ukraine. *Journal of Ethnic and Migration Studies*. 2023;49(19):4809-27.
- [23] Amiri MA, Andersson G, Vernmark K, Leiler A, Björntorp A. Profiles of psychopathology and quality of life in individuals with recent displacement experiences: a latent profile analysis. *BMC Public Health*. 2026.
- [24] Brantley ML, Kerrigan D, German D, Lim S, Sherman SG. Identifying patterns of social and economic hardship among structurally vulnerable women: a latent class analysis of HIV/STI risk. *AIDS and Behavior*. 2017;21(10):3047-56.
- [25] Matiyash O, Smyrnov P, Broadhead R. Accessing and educating female sex workers in Ukraine via a peer-driven intervention. *Retrovirology*. 2012;9(Suppl 1):P118.
- [26] Heckathorn DD. Respondent-Driven Sampling: A New Approach to the Study of Hidden Populations. *Soc Probl*. 1997;44(2):174–199.
- [27] Zhukov Y, Ayers N. VIINA 2.0: Violent Incident Information from News Articles on the 2022 Russian Invasion of Ukraine. Cambridge, MA: Harvard University. 2023. <https://github.com/zhukovyuri/VIINA>. Accessed December 11, 2025.
- [28] Weller BE, Bowen NK, Faubert SJ. Latent class analysis: a guide to best practice. *Journal of black psychology*. 2020;46(4):287-311.

- [29] Yuill RS. The standard deviational ellipse; an updated tool for spatial description. *Geografiska Annaler: Series B, Human Geography*. 1971;53(1):28-39.
- [30] Esri. How Directional Distribution (Standard Deviational Ellipse) Works; 2026. Accessed: May 26, 2026. ArcGIS Pro Documentation. Available from: <https://doc.esri.com/en/arcgis-pro/latest/tool-reference/spatial-statistics/h-how-directional-distribution-standard-deviation.html>.
- [31] Tracas A, Bazzi AR, Artamonova I, Rangel MG, Staines H, Ulibarri MD. Changes in condom use over time among female sex workers and their male noncommercial partners and clients. *AIDS Education and Prevention*. 2016;28(4):312-24.
- [32] Robertson AM, Syvertsen JL, Amaro H, Martinez G, Rangel MG, Patterson TL, et al. Can't buy my love: A typology of female sex workers' commercial relationships in the Mexico-US border region. *The Journal of Sex Research*. 2014;51(6):711-20.
- [33] Murray L, Moreno L, Rosario S, Ellen J, Sweat M, Kerrigan D. The role of relationship intimacy in consistent condom use among female sex workers and their regular paying partners in the Dominican Republic. *AIDS and Behavior*. 2007;11(3):463-70.
- [34] Magalhaes RdLB, Sousa LRM, Gir E, Galvao MTG, Oliveira VMCD, Reis RK. Factors associated to inconsistent condom use among sex workers. *Revista Latino-Americana de Enfermagem*. 2019;27:e3226.
- [35] Lazarus L, Herpai N, Pavlova D, Murney MA, Balakireva O, Tarasova T, McClarty L, Pickles M, Mishra S, Forget E, Becker M, Lorway R. Exploring the impact of military conflict on sex work in Ukraine: women's experiences of economic burden. *Glob Public Health*. 2023;18(1).
- [36] Wirtz AL, Peryshkina A, Mogilnyi V, Beyrer C, Decker MR. Current and recent drug use intensifies sexual and structural HIV risk outcomes among female sex workers in the Russian Federation. *Int J Drug Policy*. 2015;26(8):755-63.
- [37] Herpai N, Lazarus L, Forget E, Balakireva O, Pavlova D, McClarty L, Lorway R, Pickles M, Isac S, Sandstrom P, Aral S, Mishra S, Ma H, Blanchard J, Becker M. Exploring the dynamics of workplace typologies for sex workers in Eastern Ukraine. *Glob Public Health*. 2022;17(9):2034-53.
- [38] Kurmaiev P. Global market of sexual nature services. Case for Ukraine. Case for Ukraine (February 28, 2020) *Amazonia investiga*. 2020;9(26):19-27.
- [39] Ghimire L, Smith WCS, van Teijlingen ER, Dahal R, Luitel NP. Reasons for non-use of condoms and self-efficacy among female sex workers: a qualitative study in Nepal. *BMC women's health*. 2011;11(1):42.
- [40] Wirtz AL, Schwartz S, Ketende S, Anato S, Nadedjo FD, Ouedraogo HG, et al. Sexual violence, condom negotiation, and condom use in the context of sex work: results from two West African countries. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2015;68:S171-9.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [ConflictandHealthSupplementalMaterials.docx](#)