THE EPIDEMIOLOGY OF VIOLENCE AND POSTTRAUMATIC STRESS DISORDER AMONG STREET-BASED FEMALE SEX WORKERS IN BALTIMORE, MARYLAND

by

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A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland

July 2018

ABSTRACT

Background: Female sex workers (FSW) experience high levels of sexual and physical violence, posttraumatic stress disorder (PTSD) symptoms and substance use. Despite these health risks, FSW are virtually absent in the mental health literature. This dissertation examined the role of numerous dimensions of violence and substance use on PTSD symptoms using data from an observational cohort study of street-based FSW.

Methods: Street-based FSW were enrolled into The Sex workers And Police Promoting Health In Risky Environments (SAPPHIRE) cohort, an observational prospective cohort in Baltimore, Maryland. Recruitment occurred between April 2016 and January 2017 and utilized targeted sampling methods. Data from participants who completed the PTSD Checklist for DSM-5 (PCL-5) at baseline (N=230; Aims 1 & 2) and six-month follow-up (N=130; Aim 3) were included in the analyses. Several statistical methods were used to achieve the aims including Confirmatory Factor Analysis, Poisson regression, Linear regression, and Multinomial Regression.

Results: Among 230 FSW, mean age was 36 years, and mostly Non-Hispanic White (66%), followed by Non-Hispanic Black (23%) and Hispanic/Other (11%); half (51%) did not complete high school, 62% were homeless, and 86% were daily heroin/cocaine users. Most (81%) had a history of sexual/physical violence at baseline. Over half (56%) met symptom criteria for DSM-5 PTSD and 28% were subsyndromic. Factor analysis supported a 4-factor DSM-5 model of PTSD. Exposure to ≥2 violence types held a dose-response relationship with each PTSD symptom cluster ($p<0.01$).

Sexual and physical revictimization at baseline was high at 15% and 38% respectively. While all four types of violence were independently associated with PTSD severity (childhood sexual: β=14.43, 95% CI: 9.56, 19.31; adulthood sexual: β=14.04, 95% CI: 5.02, 23.06; childhood physical: β=12.35, 95% CI: 0.26-24.44; adulthood physical: β=11.02, 95% CI: 1.74-20.29), revictimization interactions were not observed ($p>0.2$). Cumulative violence had a non-linear dose-response relationship with PTSD severity ($p<0.05$). Binge drinking was also independently associated with higher PTSD severity in both multivariate models ($p<0.05$).

Recent polyvictimization was common (68%) among those exposed to violence over follow-up. Cumulative violence at baseline predicted both high stable PTSD (relative risk ratio[RR]=2.51, 95% CI: 1.61-3.90) and high-to-low PTSD (RR=1.67, 95% CI: 1.01-2.74). Recent polyvictimization and reductions in drug use as effect modifiers did not reach statistical significance.

Conclusions: Findings from this dissertation highlight that street-based FSW have a complex set of health needs and experience high levels of violence over the life course. Trauma-informed interventions will need to concurrently address PTSD symptoms, ongoing violence from multiple sources, and comorbidities including active drug and alcohol use. Interventions addressing violence against FSW must be non-stigmatizing and sensitive to the realities and needs of this structurally vulnerable population in order to be successful. Engaging police and the criminal justice system will likely be required in order to make a sustainable impact.

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ACKNOWLEDGMENTS

I am sincerely grateful to many people who have influenced me over the years.

Firstly, I would like to thank my advisor Dr. Susan Sherman, who is a fierce harm reduction advocate, brilliant researcher, and an inspiration to me and many others in the field. I am deeply thankful for her mentorship, belief and support of me over the years. She has provided me with incredible research and teaching opportunities. I am grateful to her for hiring me to work on SAPPHIRE, entrusting me with this dissertation topic and for helping me to broaden my understanding of health and research, from theory to practice.

To the fantastic SAPPHIRE team (Katherine Footer, Steve Huettner, Brad Silberzahn, Eddie Poole, Jackie Toppins, Miles Morris, Dr. Sean Allen, Dr. Michele Decker, Dr. Noya Galai and many others) and the SAPPHIRE study participants – without all of you, this research would not be possible. Thank you for your dedication and encouragement. The loss of our dear colleague and several women in our study over the past two years will not be forgotten.

It has been a pleasure learning from the members of my thesis and exam committee. I am grateful to Dr. Judith Bass, who guided me through the mental health literature, challenged me to think outside the box, and offered much support throughout the dissertation process. I am grateful to Dr. Noya Galai and Dr. Qian-Li Xue for encouraging me to explore a range of epidemiologic and statistical methods and their underlying assumptions and limitations throughout the dissertation process. I thank Dr. Michele Decker for introducing me to the

gender-based violence field and her continual encouragement over the years. I also thank Dr. Noya Galai and Dr. Karin Tobin for their insightful feedback in the final stages of the dissertation process, I thank Dr. Caitlin Kennedy for being an alternate examinee, and thank Dr. Carl Latkin and Dr. Tonia Poteat for providing valuable input during the early stages of developing my research proposal.

My interest in mental health and substance use led to applying for my first job out of college on a cohort study of people who inject drugs in Sydney, Australia. I am sincerely grateful to Dr. Lisa Maher for welcoming me to the field of public health and to the HITS-c study team, and for introducing me to my future doctoral advisor. Without Dr. Maher's mentorship over the years, I may have never ended up in this field nor studied at Johns Hopkins. The compassion and dedication that you have towards the populations we work with continues to inspire me.

I owe gratitude to Dr. Shruti Mehta, Dr. Stefan Baral and Dr. Chris Beyrer for the research opportunities and mentorship they provided me as a master's student; to this day, their advice resonates with me and they continue to be a source of inspiration. I am also indebted to Dr. Danielle German, Colin Flynn and the BESURE team for supporting me in gaining first-hand experience in research, particularly on data management and stakeholder engagement. Thank you all for providing me with solid research training prior to the PhD program.

I am deeply grateful to Dr. David Celentano, the Department of Epidemiology, and faculty for accepting me into such a wonderful program. I also thank Fran Burman and Matt Miller for their support and advice. I acknowledge and thank the NIH for funding this research study and the Charlotte Silverman fund for providing additional support for the PhD program.

To all my friends in Baltimore and beyond, the epi cohort and my WAG ladies Kriti and Marik – I could not have done this without your support, particularly through the hard times. Thanks for being my second family away from home. Thank you to my cousin Hye-Jin and her family for being there for me over the years.

I thank my parents, who immigrated to Australia when I was nine years old, and have supported me in pursuing my dreams. My father always encouraged me to study in the U.S. and dream big. My mother demonstrated to me the value of education and work – she is one of the hardest workers that I know. Thank you for letting me move across the globe. And to my sister Jae Hee – I know the distance wasn't easy.

This dissertation is dedicated to those affected by gender-based violence worldwide.

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CHAPTER ONE: INTRODUCTION

Background

Contextualizing the health of female sex workers

Female sex workers (FSW), defined by Joint United Nations Programme on HIV/AIDS as women "who receive money or goods in exchange for sexual services" constitute a diverse population of women who work in a variety of sanctioned and unsanctioned settings, including clubs, brothels and online spaces.[1] "Street-based" sex work describes transactional sex that occurs in outdoor settings including streets, roadsides, alleyways and parks.[2] Street-based FSW are a subgroup characterized by high marginalization and multiple health morbidities, including trauma, mental health disorders and substance use.

FSW's autonomy and agency to protect their own health exists in the context of broader social and structural forces. In this introductory chapter, the author provides an overview of the Theory of Gender and Power, and the Structural Vulnerability framework, which were instrumental in developing the current dissertation.[3-6] The latter part of the chapter focuses on the role of trauma in the lives of FSW – specifically exposure to sexual and physical violence – and concludes with an overview of the epidemiology of posttraumatic stress disorder (PTSD), a subsequent mental health condition for many victims of violence in the general community and among FSW, as well as current gaps in the literature. This dissertation topic was chosen by the author in part due to the disturbing details of the sexual and physical violence disclosed to her during interviews with FSW in the field and learned about during field staff debriefs, alongside the observation that PTSD studies that include FSW remain virtually absent in the mental health literature. Given our knowledge of the social, economic and structural forces shaping the lives of FSW, we

hypothesized that high rates of violence and PTSD symptoms among FSW would be observed. The goal of this dissertation is to add nuance to the literature and identify the implications for future research, programming and policy to help improve the health of this marginalized and underserved population.

The Social Structure of Gender

The "social structure of gender" permeates every aspect of our professional and private lives, however the negative consequences attributable to gendered dynamics most acutely affect women of low socioeconomic status worldwide.[3,7] Structures have been conceptualized by Giddens in the Theory of Structuration as the patterning of rules and resources organized within social systems that can restrain or enable individual agency; examples of key structures include laws, policies, and enduring social rules.[4] While often not the topic of public health discourse and research, laws constitute the most strongly enforced types of social rules that can generate structural vulnerability.[4,5] Informed by Giddens' work, Connell's social Theory of Gender and Power underscores the key role of gender as a social structural that shapes the lives of women; this theory illuminates that individual agency is shaped by inequalities in the micro- and macro-structural realms of labor and power, as well as pervasive and deep-rooted sociocultural norms and interpersonal interactions. Specifically, the four domains explicated by Connell are the "sexual division of labor" (e.g., assigning women to administrative roles and men to higher-paying leadership positions; unpaid childrearing), power dynamics (e.g., workplace sexual assault of an employee by a supervisor), "cathexis" (e.g., expectations of female subservience towards men), and "symbolism, culture and discourse" (e.g., societal shaming

of female sexual assault victims; cultural tolerance of sexual assault committed in the presence of alcohol).[7] These gendered dynamics increase the vulnerability of women, particularly women with lower socioeconomic status, and perpetuate gender-based health disparities.

Within the formal and informal sex industry, men have historically have held positions of power, control and wealth, as business owners, managers, pimps, and clients who purchase sexual services.[8,9] Even among FSW who work independently of management, their financial dependence on their male clients creates an inherent power differential and negotiation of the terms of the sexual encounter occurs within this power dynamic. Understanding the role of gender informed our understanding of the dynamics surrounding sex work and shaping the health of FSW throughout this dissertation.

Structural vulnerability and chronic strain among FSW

Structural vulnerability is described by Quesada and colleagues[1] as an individual's "positionality…in a hierarchical social order and its diverse networks of power relationships and effects" and the "embodiment of subordinated status," which "constrain decision-making, frame choices, and limit life options." Examples of structurally vulnerable populations include FSW, communities entrenched in poverty, and homeless communities. The concept has been applied to examine HIV risk among people who inject drugs, female exotic dancers and FSW[5,10] The structural vulnerability of FSW stem from factors that affect women more broadly such as poverty, adverse childhood experiences and housing instability as well as those exacerbated by engagement in sex work such as social stigmatization, occupational stress and criminal justice involvement.[5,11] Early

structural vulnerability can explain the reason many women enter street-based sex work; this form of sex work often provides a method of economic survival for women with limited formal and informal opportunities for generating income.[2,9] Drug addiction, which disproportionately affects structurally vulnerable communities, also appears to have a role in women's engagement in street-based sex work.[2] For example, the need to financially sustain heroin and crack cocaine dependence, is a common reason for sex work engagement among street-based FSW in the U.S. Researchers have observed that informal sex work and drug economies are often socially and spatially intertwined though positions of power are often held by men.[9]

Escalating the structural vulnerability of FSW in many settings, including the U.S., is the heavier enforcement of supply-side sex work criminalization laws, which further stigmatize FSW and disregard their autonomy to make decisions that align with their social and economic circumstances. FSW largely remain criminalized often more so than their male clients who are also complicit in sex exchange encounters. The high criminalization of sex work and drug use results in high involvement of FSW in the criminal justice system.[12] In 2015 alone, over 40,000 prostitution-related arrests were reported to the U.S. Federal Bureau of Investigation (FBI).[13] In the state of Maryland, prostitution is defined as any sexual act, sexual contact, or vaginal intercourse exchanged for money (Md. Code Ann. [Crim. Law], § 11-301) and is punishable by up to one year imprisonment. A study of 616 FSW arrestees in Baltimore, Maryland demonstrated high levels of trauma and psychological distress.[14] Except in settings such as Sweden where clients are criminalized instead of sex workers, FSW are often the target of police arrest.[15] Paradoxically, sex work recidivism i.e. repeat offenses when examined is high.[16,17]

FSW are often policed by male officers who directly and indirectly impact their ability to protect their health (e.g., directly through confiscation of condoms, or by using fear of arrest to coerce sexual favors, or indirectly where FSW feel pressured to rush client negotiations due to the presence of police).[18,19] FSW may also experience sexual and physical violence at the hands of police.[20,21] Police apathy has been observed when responding to FSW when seeking help following assault.[11,22] The role of gendered power and labor dynamics on FSW health has been explored in relation to their risk of HIV/STI acquisition[9,23,24] but is yet to be examined in relation to their trauma and mental health needs.

Populations at high risk of structural vulnerability in the occupational and personal life domains are more likely to experience chronic stress, a condition that is generated by ongoing exposure to frequently occurring demands also known as "chronic strain" and associated with adverse physiologic and mental health outcomes.[25,26] Examples of recurring sources of stress that certainly can affect FSW include financial hardship, interpersonal conflict, and threat of violence.[27] At the population level, the burden of chronic strain is observed to be socially structured and "patterned" by social class and social roles, for example it disproportionately affects women, and populations from lower socioeconomic backgrounds.[26] In addition to chronic strain, traumas are another key source of stress that affects the health of FSW that will be discussed in the following section; we considered both forms of stress in our research.

Violence against women and FSW

Trauma is a response to a life-threatening event or exposure to a serious injury or sexual violence.[28] Traumatic events may be directly experienced, witnessed, or learned about (i.e., exposure to a close friend or family member). Repeated and extreme exposure through occupational duties (e.g., common among first responders, military personnel and media reporters) can also inflict trauma. Examples of traumatic events include accidents, natural disasters, war and assaultive forms of violence (i.e. sexual and physical violence, also known as "interpersonal violence"). Assaultive violence can result in the sequelae of a range of physical and mental health conditions, including injury, chronic gynecological problems, PTSD, depression, anxiety and substance use coping.[29-31]

Sexual and physical violence against women and girls remains a pressing public health issue globally, primarily perpetrated by men and, and driven at the population-level by the ramifications of the social structure of gender.[7,32,33] A third of all women in the U.S. and worldwide have been exposed to sexual or physical violence in their lifetime.[32,34] Women are more likely to be raped than men.[35] FSW are no exception; they bear a disproportionate burden of violence compared to the overall female population.[36] Among FSW and women more broadly, exposure to violence often starts in early childhood; for example, 42% of completed rapes occurred during childhood among U.S. women[32] and more than 50% of FSW report childhood abuse.[37-39] Though less attention has been given to intimate partner violence (IPV) as an issue among FSW compared to client violence and childhood abuse, IPV is a key global health issue for FSW and for women; in the U.S. alone, one in four women are victims of IPV half of whom exhibit symptoms of posttraumatic stress disorder (PTSD).[32] Higher IPV rates are observed in countries of

gendered social norms and policies that justify gender-based violence and economically favor men.[33]

Among FSW, the risk of violence exposure is considerably heightened due to unique dynamics inherent in their work environment. Their work environment is dominated by the presence of men namely clients, pimps, and police who often perpetrate an array of coercive, violent and degrading practices that violate their human rights.[21,36,40] Salient examples of sexually and physically violent encounters that FSW experience include being raped by clients, thrown out by clients from moving cars, being robbed of their earnings by a pimp with a weapon, and beaten up by police officers.[20,21,24,41,42] Given that violence is also prominent in their private lives (childhood and intimate relationships), an accumulated violence model may be most appropriate in modeling the impact of violence among this population.[43] The prevalence of revictimization (defined as recurring violence by type e.g. sexual violence as a child and as an adult) and polyvictimization (defined as multiple types of violence e.g. exposure to sexual and physical violence) are understudied in quantitative FSW studies, however it is expected that prevalence will be high based on their vulnerability. Given that the threat of violence is a frequent reality for street-based FSW who are often immersed in a "subculture of violence" throughout their lives, a cumulative life course perspective of violence among street-based FSW is warranted.[43,44]

The epidemiology of PTSD among women and gaps in the FSW literature

PTSD is a mental health disorder defined by the American Psychiatric Association as consisting of exposure to a traumatic event (criterion A), moderate levels of four groups

of symptoms, which are classified as re-experiencing symptoms (criterion B), avoidance symptoms (criterion C), negative cognitions and mood (criterion D), and arousal symptoms (criterion E). Symptoms must last for more than a month (criterion F), create distress or functional impairment (criterion G) and not due to medication, substance use or other illness (criterion H).

The vast majority of adults will experience at least one traumatic event in their lifetime, however, most do not develop chronic PTSD.[45-47] The lifetime prevalence of PTSD in the general population is 9%.[48] The risk of developing PTSD in community-based samples differs based on whether the trauma was violent in nature; war and assaultive violence confers the highest risk of developing PTSD compared to other types of traumatic events.[47] Older adolescents and younger adults are at higher risk of trauma.[45] PTSD is the most common mental health condition that can develop following traumatic events including assaultive violence. Other PTSD risk factors include lower socioeconomic status, family psychiatric history, early trauma, perceived life threat during the trauma and low social support.[49,50] Women are more likely to be exposed to sexual violence than men, twice as likely to develop PTSD compared to men, and experience longer symptom persistence over time even after controlling for trauma type.[35,45] Among female IPV survivors, at least half will develop symptoms of PTSD.[32] A small body of longitudinal PTSD studies show that among survivors of violence, PTSD symptoms gradually increases after one year, whereas PTSD symptoms decrease among other trauma groups; late onset (absence at post-trauma baseline and presence at follow-up) is quite rare (4%).[47]

FSW remain virtually absent in the mental health literature. The few studies that focus on FSW have shown that PTSD prevalence among this population ranges from 47%

to 69% i.e., more than four times higher than the general population of women.[51-53] Factors associated with PTSD in these FSW studies, which were conducted over a decade ago, include childhood neglect and sexual assault. There is a pressing need for updated research on the epidemiology of PTSD among FSW.

Substance use disorders (SUD) are the most common PTSD co-morbidity in the general population that complicate treatment and result in worse prognosis and clinical outcomes. Substance use is also a powerful condition that drive and sustains engagement in street-based sex work. The vast majority of urban street-based FSW surveyed in the U.S. use heroin or cocaine.[51,54] However, the role of substance use in the etiology of PTSD among FSW remains unknown.

Bidirectional relationships between structural vulnerability and trauma are emerging in the literature. High rates of childhood abuse are reported among homeless samples[55] and homelessness is a risk factor for exposure to violence among FSW.[56] High structural vulnerability exists among FSW yet its relationship to mental health outcomes in the context of exposure to cumulative violence are yet to be elucidated. This dissertation will investigate the relationship between structural vulnerability, violence, substance use and mental health among FSW.

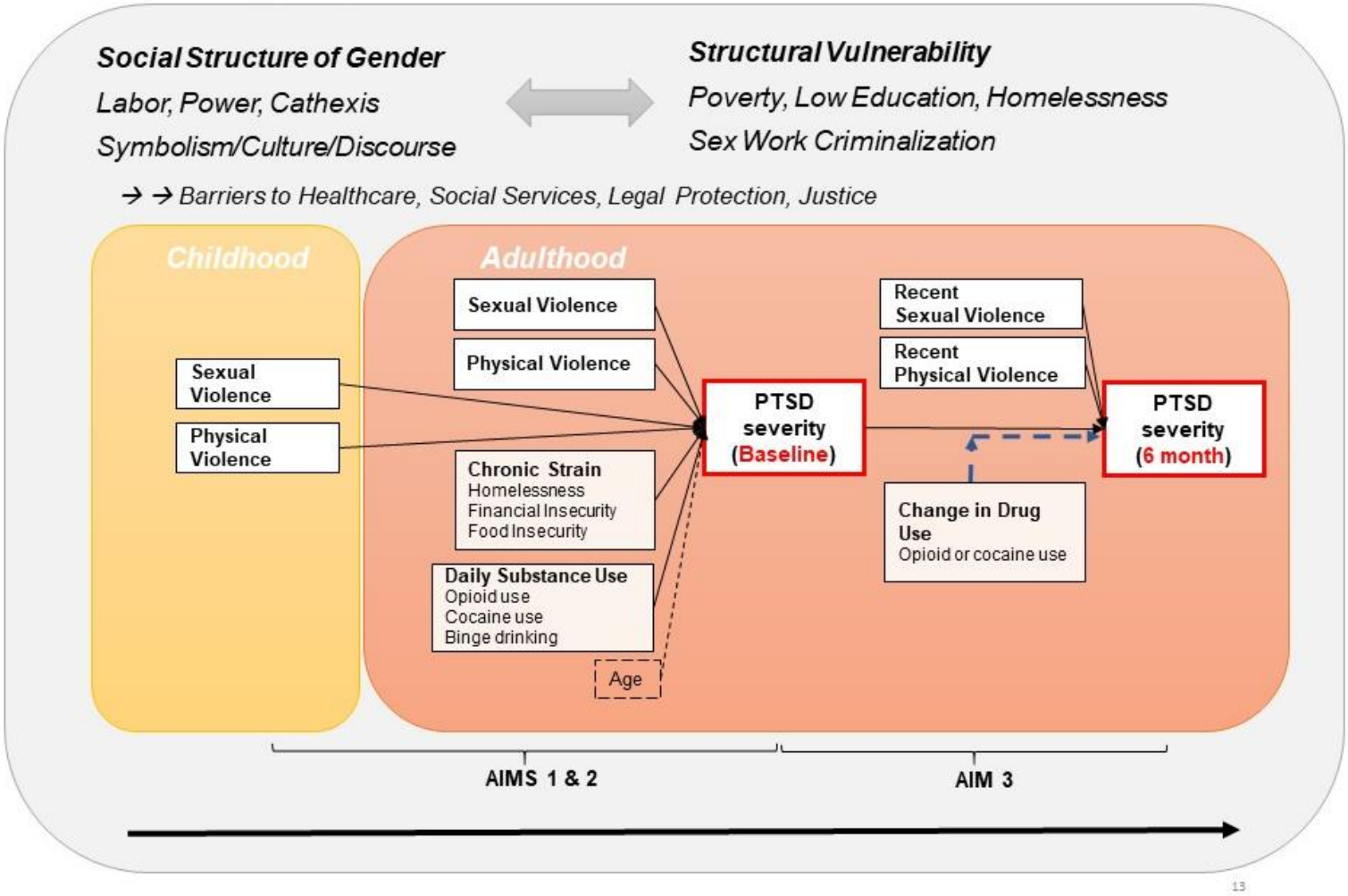
Aims and conceptual framework

The Sex workers And Police Promoting Health In Risky Environments (SAPPHIRE) study, which enrolled participants between April 2016 and January 2017 in Baltimore, Maryland, is the first observational prospective cohort study of street-based FSW conducted in the U.S. (R01DA038499). This research was conducted using data from the cisgender FSW cohort (N=230). The specific aims of this research were:

1. To examine the factor structure of PTSD symptoms, individual-level PTSD symptom cluster patterns and associations between sexual and physical violence and PTSD symptom clusters among FSW (N=230);
2. To assess the prevalence of five dimensions of violence (violence type, perpetrator groups, revictimization, polyvictimization and cumulative violence) and to examine relationships between Revictimization, cumulative violence and PTSD severity in the presence of co-occurring chronic strain and substance use among FSW (N=230);
3. To investigate the impact of recent violence on changes in PTSD severity from baseline to 6-month follow-up and to test whether reductions in substance use moderate this relationship among FSW (N=137).

The conceptual framework developed for this research draws from a range of theories and disciplines, including sociology, medical and public health literature, and research on trauma, PTSD, chronic strain and is depicted in **Figure 1**.[3-5,7,25,26,57] The pathways between violence and PTSD over the life course are hypothesized to be influenced by chronic strain and substance use, and exist in a context of gendered dynamics and structural determinants that pose barriers to seeking health, social and legal services.

Figure 1: Conceptualizing the relationship between cumulative violence and PTSD



References

1. Joint United Nations Programme on HIV/AIDS (UNAIDS). *UNAIDS Guidance Note on HIV and Sex Work.* Geneva, Switzerland: UNAIDS;2012.
2. Vanwesenbeeck I. Another decade of social scientific work on sex work: a review of research 1990-2000. *Annu Rev Sex Res.* 2001;12:242-289.
3. Connell RW. *Gender and power: Society, the person and sexual politics.* Stanford University Press; 1987.
4. Giddens A. *The constitution of society: Outline of the theory of structuration.* Univ of California Press; 1984.
5. Rhodes T, Wagner K, Strathdee SA, Shannon K, Davidson P, Bourgois P. Structural violence and structural vulnerability within the risk environment: theoretical and methodological perspectives for a social epidemiology of HIV risk among injection drug users and sex workers. In: *Rethinking social epidemiology.* Springer; 2012:205-230.
6. Quesada J, Hart LK, Bourgois P. Structural vulnerability and health: Latino migrant laborers in the United States. *Medical anthropology.* 2011;30(4):339-362.
7. Connell R, Pearse R. *Gender: In World Perspective.* . 3rd edition ed: Polity; 2014.
8. Wingood GM, DiClemente RJ. Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. *Health education & behavior.* 2000;27(5):539-565.
9. Maher L, Curtis R. Women on the edge of crime: Crack cocaine and the changing contexts of street-level sex work in New York City. *Crime, law and social change.* 1992;18(3):221-258.
10. 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 Behav.* 2017;21(10):3047-3056.
11. Alexander P. Sex work and health: a question of safety in the workplace. *J Am Med Womens Assoc.* 1998;53(2):77-82.
12. Strathdee SA, West BS, Reed E, Moazen B, Azim T, Dolan K. Substance Use and HIV Among Female Sex Workers and Female Prisoners: Risk Environments and Implications for Prevention, Treatment, and Policies. *J Acquir Immune Defic Syndr.* 2015;69 Suppl 2:S110-117.
13. Federal Bureau of Investigation Uniform Crime Reporting (UCR) Program. 2015 crime in the United States: Table 29, estimated number of arrests. https://ucr.fbi.gov/crime-in-the-u.s/2015/crime-in-the-u.s.-2015/tables/table-29. Accessed 11/20/2016.
14. Shdaimah C, Bailey-Kloch M. "Can You Help With That Instead of Putting Me in Jail?": Participant Insights on Baltimore City's Specialized Prostitution Diversion Program. *Justice System Journal.* 2014;35(3):287-300.

15. Vanwesenbeeck I. Sex work criminalization is barking up the wrong tree. *Archives of sexual behavior.* 2017;46(6):1631-1640.

16. Weitzer R. Prostitution control in America: Rethinking public policy. *Crime, Law & Social Change.* 1999;32:83–102.

17. Roe-Sepowitza DE, Hicklea KE, Loubertb MP, Eganc T. Adult Prostitution Recidivism: Risk Factors and Impact of a Diversion Program. *Journal of Offender Rehabilitation.* 2011;50(5):272-285.

18. Shannon K, Strathdee SA, Goldenberg SM, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet.* 2015;385(9962):55-71.

19. Footer KH, Silberzahn BE, Tormohlen KN, Sherman SG. Policing practices as a structural determinant for HIV among sex workers: a systematic review of empirical findings. *Journal of the International AIDS Society.* 2016;19(4Suppl 3).

20. Rhodes T, Simic M, Baros S, Platt L, Zikic B. Police violence and sexual risk among female and transvestite sex workers in Serbia: qualitative study. *BMJ.* 2008;337:a811.

21. Erausquin JT, Reed E, Blankenship KM. Police-related experiences and HIV risk among female sex workers in Andhra Pradesh, India. *J Infect Dis.* 2011;204 Suppl 5:S1223-1228.

22. Sherman SG, Footer K, Illangasekare S, Clark E, Pearson E, Decker MR. "What makes you think you have special privileges because you are a police officer?" A qualitative exploration of police's role in the risk environment of female sex workers. *AIDS Care.* 2015;27(4):473-480.

23. Sherman SG, Latkin CA, Gielen AC. Social factors related to syringe sharing among injecting partners: a focus on gender. *Substance Use & Misuse.* 2001;36(14):2113-2136.

24. Shannon K, Kerr T, Allinott S, Chettiar J, Shoveller J, Tyndall MW. Social and structural violence and power relations in mitigating HIV risk of drug-using women in survival sex work. *Social science & medicine.* 2008;66(4):911-921.

25. Thoits PA. Stress and health: Major findings and policy implications. *Journal of health and social behavior.* 2010;51(1_suppl):S41-S53.

26. Turner RJ, Wheaton B, Lloyd DA. The epidemiology of social stress. *American sociological review.* 1995:104-125.

27. Vanwesenbeeck I. Burnout among female indoor sex workers. *Archives of sexual behavior.* 2005;34(6):627-639.

28. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub; 2013.

29. Campbell JC. Health consequences of intimate partner violence. *Lancet.* 2002;359(9314):1331-1336.

30. Breslau N, Davis GC, Andreski P, Peterson E. Traumatic events and posttraumatic stress disorder in an urban population of young adults. *Archives of general psychiatry.* 1991;48(3):216-222.

31. Stewart SH, Pihl RO, Conrod PJ, Dongier M. Functional associations among trauma, PTSD, and substance-related disorders. *Addict Behav.* 1998;23(6):797-812.

32. Black MC, Basile KC, Breiding MJ, et al. The national intimate partner and sexual violence survey (NISVS): 2010 summary report. *Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.* 2011;25.

33. Heise LL, Kotsadam A. Cross-national and multilevel correlates of partner violence: an analysis of data from population-based surveys. *The Lancet Global Health.* 2015;3(6):e332-e340.

34. Devries KM, Mak JY, García-Moreno C, et al. The global prevalence of intimate partner violence against women. *Science.* 2013;340(6140):1527-1528.

35. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of general psychiatry.* 1995;52(12):1048-1060.

36. Deering KN, Amin A, Shoveller J, et al. A systematic review of the correlates of violence against sex workers. *Am J Public Health.* 2014;104(5):e42-54.

37. Kurtz SP, Surratt HL, Inciardi JA, Kiley MC. Sex work and "date" violence. *Violence against women.* 2004;10(4):357-385.

38. Argento E, Muldoon KA, Duff P, Simo A, Deering KN, Shannon K. High prevalence and partner correlates of physical and sexual violence by intimate partners among street and off-street sex workers. *PLoS One.* 2014;9(7):e102129.

39. Hong Y, Zhang C, Li X, Liu W, Zhou Y. Partner violence and psychosocial distress among female sex workers in China. *PLoS One.* 2013;8(4):e62290.

40. Decker MR, Crago AL, Chu SK, et al. Human rights violations against sex workers: burden and effect on HIV. *Lancet.* 2015;385(9963):186-199.

41. Wirtz AL, Schwartz S, Ketende S, 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-S179.

42. Lim S, Peitzmeier S, Cange C, et al. Violence against female sex workers in Cameroon: accounts of violence, harm reduction, and potential solutions. *JAIDS Journal of Acquired Immune Deficiency Syndromes.* 2015;68:S241-S247.

43. Scott-Storey K. Cumulative abuse: do things add up? An evaluation of the conceptualization, operationalization, and methodological approaches in the study of the phenomenon of cumulative abuse. *Trauma, Violence, & Abuse.* 2011;12(3):135-150.

44. Surratt HL, Inciardi JA, Kurtz SP, Kiley MC. Sex work and drug use in a subculture of violence. *Crime & Delinquency.* 2004;50(1):43-59.

45. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of general psychiatry.* 1998;55(7):626-632.

46. Bonanno GA, Mancini AD, Horton JL, et al. Trajectories of trauma symptoms and resilience in deployed U.S. military service members: prospective cohort study. *Br J Psychiatry.* 2012;200(4):317-323.

47. Santiago PN, Ursano RJ, Gray CL, et al. A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. *PloS one.* 2013;8(4):e59236.

48. Kessler RC, Chiu WT, Demler O, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry.* 2005;62(6):617-627.

49. Ozer EJ, Best SR, Lipsey TL, Weiss DS. Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychol Bull.* 2003;129(1):52-73.

50. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol.* 2000;68(5):748-766.

51. Surratt HL, Kurtz SP, Weaver JC, Inciardi JA. The Connections of Mental Health Problems, Violent Life Experiences, and the Social Milieu of the "Stroll" with the HIV Risk Behaviors of Female Street Sex Workers. *Journal of Psychology & Human Sexuality.* 2005;17(1-2):23-44.

52. Roxburgh A, Degenhardt L, Copeland J. Posttraumatic stress disorder among female street-based sex workers in the greater Sydney area, Australia. *BMC Psychiatry.* 2006;6:24.

53. Farley M, Cotton A, Lynne J, et al. Prostitution and trafficking in nine countries: An update on violence and posttraumatic stress disorder. *Journal of Trauma Practice.* 2004;2(3-4):33-74.

54. El-Bassel N, Witte SS, Wada T, Gilbert L, Wallace J. Correlates of partner violence among female street-based sex workers: substance abuse, history of childhood abuse, and HIV risks. *AIDS patient care and STDs.* 2001;15(1):41-51.

55. Coates J, McKenzie-Mohr S. Out of the frying pan, into the fire: Trauma in the lives of homeless youth prior to and during homelessness. *J Soc & Soc Welfare.* 2010;37:65.

56. Shannon K, Kerr T, Strathdee SA, Shoveller J, Montaner JS, Tyndall MW. Prevalence and structural correlates of gender based violence among a prospective cohort of female sex workers. *BMJ.* 2009;339:b2939.

57. Breslau N. Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. In: SAGE Publications Sage CA: Los Angeles, CA; 2002.

CHAPTER TWO: MANUSCRIPT ONE

Posttraumatic Stress Disorder among urban female sex workers: Factor structure, cluster patterns and associations with sexual and physical violence.

Abstract

Female sex workers (FSW) experience high levels of violence and mental health burden. Street-based FSW are particularly vulnerable to the negative social and structural conditions that increase their risk of these factors, yet are an underrepresented population in the modern mental health literature. We examined the factor structure, and DSM-5 symptom cluster patterns of PTSD symptoms among an urban sample of street-based FSW (N=230). Poisson regression was used to model age-adjusted associations between violence and PTSD symptom clusters. The majority had experienced sexual or physical violence as children and/or adults (81%). Most (62%) were homeless; the majority (86%) used heroin and/or cocaine daily. Most FSW exhibited PTSD symptoms (61%), the majority of whom (77%) had never been clinically diagnosed. Over half (56%) provisionally met symptom criteria for DSM-5 PTSD, 28% were subsyndromal and 17% did not endorse any clusters. Almost half had co-morbid PTSD-depression symptoms, and co-occurring PTSD and daily substance use. The 4-factor DSM-5 model and 5-factor DSM-IV dysphoric arousal model of PTSD were supported. Exposure to ≥2 violence types held a dose-response relationship with each PTSD symptom cluster (p<0.01). These findings highlight that street-based FSW are a population at high risk of trauma who face multiple morbidities, and that there is an urgent need for trauma-informed mental health services targeting these women that are integrated and non-stigmatizing.

Introduction

Posttraumatic stress disorder (PTSD) is a mental health disorder that can develop following direct or indirect exposure to traumatic events. Historically, PTSD has been studied most intensively among male military veterans, survivors of catastrophic events and sexual assault survivors (Herman, 2015). The risk of developing PTSD is highest among survivors of assaultive violence, defined as exposure to sexual or physical violence (Breslau et al., 1998).

Female sex workers (FSW), defined as women who exchange sex for money, drugs, favors, or goods, are an underrepresented population in the modern mental health literature, despite being heavily affected by a unique set of social and structural vulnerabilities that increase their risk of violence and PTSD (Decker et al., 2015). A small body of literature has documented high prevalence of PTSD or traumatic stress symptoms among FSW (>47% of samples) (Farley et al., 2004; Roxburgh, Degenhardt, & Copeland, 2006; H.L. Surratt, Kurtz, Weaver, & Inciardi, 2005), and provided exploratory insights into risk factors; the majority of FSW with PTSD symptoms in these studies were neglected as a child, experienced sexual assault during adulthood and had comorbid depression symptoms. Several studies have shown an association between PTSD and sex work without examining the findings further (e.g. symptomology or factor structure) (Farley et al., 2004; Hutton et al., 2001).

More than a decade has passed since these research studies were conducted and none focused on DSM-defined symptom clusters. Symptom clusters at the patient-level are relatively stable over time (Bremner, 1999). It is critical to explore symptom clusters since in other female populations, DSM-defined clusters have been shown to be associated

with a range of negative psychosocial outcomes including relationship distress and daily functioning (Renshaw, Campbell, Meis, & Erbes, 2014; Shnaider et al., 2014).

Violence is a pervasive issue for FSW throughout the life course. Exposure to sexual and physical violence often begins early in life with estimates of childhood abuse ranging from 50%-66% among FSW in North America (Deering et al., 2014; Rossler et al., 2010; H.L. Surratt et al., 2005). Intimate partner violence (IPV) is an increasingly recognized source of sexual, physical and psychological violence for FSW with one study reporting lifetime prevalence of 58% (Hong, Zhang, Li, Liu, & Zhou, 2013). Perpetrators of sexual and physical violence may also include clients and police; a global systematic review revealed that the lifetime prevalence of workplace violence among FSW ranged from 45%-75% (Deering et al., 2014). FSW are at high risk of homicide though data are scarce (Decker et al., 2015; J. J. Potterat et al., 2004).

FSW are socially and structurally vulnerable in part due to the criminalization and stigma surrounding sex work (Shannon et al., 2015). These factors shape police officer apathy when violence is reported by FSW; for example, some officers hold the erroneous belief that a sex worker cannot be raped. Fear of being arrested by police is a major deterrent among FSW in reporting victimization to police and reduce the likelihood of the victim's ability to receive legal justice (Decker et al., 2015; Sherman et al., 2015). In many settings, male police officers exploit this power dynamic by using the threat of arrest as a method to pressure FSW for sex and bribes (Decker, Pearson, Illangasekare, Clark, & Sherman, 2013; Erausquin, Reed, & Blankenship, 2011; Rhodes, Simic, Baros, Platt, & Zikic, 2008).

Interestingly, PTSD does not inexorably follow traumatic experiences; most survivors of war and violence will make a recovery within a month of exposure (Bonanno et al., 2012; Santiago et al., 2013; Walsh et al., 2012; White et al., 2015). Risk factors for developing PTSD include female gender, having a family member with a psychiatric history, lower socioeconomic status, prior trauma (e.g. childhood trauma), sexual trauma, perceived life threat during the trauma and social support (Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003). FSW are subsequently vulnerable to developing chronic PTSD; in addition to violent encounters, many face structural barriers early in life including poverty and homelessness, high rates of childhood sexual abuse, and social marginalization from the stigma surrounding their work (H. L. Surratt, Kurtz, Chen, & Mooss, 2012; Vanwesenbeeck, 2001).

In the general population, PTSD often presents as a comorbid condition to substance use disorders (Kessler, Chiu, Demler, & Walters, 2005; Rytwinski, Scur, Feeny, & Youngstrom, 2013). Exposure to recent violence has been shown to increase the risk of PTSD and substance use (Hedtke et al., 2008). This is particularly relevant for street-based FSW, who often enter sex work to support their drug use and are criminalized for both sex work and drug use, which render them vulnerable to cycles of arrest and re-victimization (Deering et al., 2014; Inciardi & Surratt, 2001). FSW may also use drugs and alcohol as a coping mechanism for the challenges that often accompany sex work including the risk of violence and stigma. The presence of comorbidities have implications for designing mental health interventions and strengthening service delivery to these women given that patients with comorbidities often have poorer treatment outcomes (Flanagan, Korte, Killeen, & Back, 2016).

Investigating the phenomenological and psychometric characteristics of PTSD among FSW likely will add to the existing debate on the validity of the recent changes made to the DSM-5 criteria for the clinical diagnosis of PTSD, and also provide insights into improved screening, prevention and treatment for FSW and perhaps other high-trauma populations. Accordingly, this study examines the prevalence of conditions that co-occur with PTSD symptoms, diagnostic cluster patterns and factor structure of PTSD symptoms among an urban sample of street-based FSW.

Methods

Participants

The Sex workers And Police Promoting Health In Risky Environments (SAPPHIRE) study is an ongoing prospective cohort study of FSW recruited between April 2016 and January 2017 in Baltimore, Maryland. A detailed description of the recruitment methods and study procedures are published elsewhere (manuscripts under review). Eligibility criteria for the SAPPHIRE cohort of FSW are as follows: (1) age ≥ 15 years; (2) sold or traded oral, vaginal or anal sex "for money or things like food, drugs or favors"; (3) picked up clients on the street or at public places ≥ 3 times in the past 3 months; (4) willing to undergo HIV and STI testing. Exclusion criteria were: (1) identifying as male or as a man.

Eligible participants who provided informed consent participated in a 50-minute computer assisted personal interview (CAPI) with a trained interviewer. At the end of the survey, the interviewer offered referrals to local health and social service organizations as appropriate (e.g. violence shelter, case management, mental health and drug treatment programs). Participants were compensated with a pre-paid $70 VISA gift card for

completing the baseline visit. The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

i. PTSD symptoms

PTSD symptoms were measured using the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5), a 20-item self-reported screening scale that asks about symptoms in the past month, with responses for each symptom coded using a 5-point Likert scale (not at all, a little bit, moderately, quite a bit, extremely); overall score indicating "PTSD symptom severity" can range from 0 to 80 (Weathers et al., 2013). In our study, this scale was self-administered on a tablet. This scale has been validated among veterans and college students; in these populations, PCL-5 has demonstrated excellent internal consistency (Cronbach's alpha=0.95-0.96); strong test–retest reliability (r=0.82-0.84); convergent and discriminant validity; and sensitivity (0.88) and specificity (0.69) compared to a structured clinical diagnosis (Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016; Hoge, Riviere, Wilk, Herrell, & Weathers, 2014). This scale was originally developed for use at the U.S. Department of Veterans Affairs National Center for PTSD and revised in 2013 to reflect changes made to diagnostic criteria between the DSM-IV and DSM-5. The previous DSM-IV version of the scale consisted of a Civilian version and a Veteran version of the scale, which were collapsed to create the PCL-5. Kappa scores comparing the DSM-5 criteria to DSM-IV range from 0.66–0.78 among military veterans (Hoge et al., 2014).

Of the women who were administered the scale (N=236), 97% (N=230) completed the full scale. A cut off of 33 has been validated among veterans with a Kappa score of 0.58 compared to the Clinician-Administered PTSD Scale for DSM–5 (CAPS-5) (Hoge et al., 2014); accordingly, a dichotomous variable indicating presence of "clinically significant PTSD symptoms" was constructed using PCL-5 score ≥ 33.

The DSM-5 defines PTSD consisting of the following criteria: (1) criterion A: patients must have directly or indirectly been exposed to death, serious injury or sexual violence; (2) to meet criterion B to E, patients must have the following types of symptoms for at least one month to meet PTSD symptom criteria: intrusion symptoms (criterion B), avoidance of stimuli (criterion C), Negative cognition or mood (criterion D), alterations in arousal and reactivity (criterion E).

We scored the PCL-5 using methodology recommended by the developers (Weathers et al., 2013). The following responses for each of the 20 items were collapsed into binary variables (yes/no) indicating whether the symptom was reported: *moderately, quite a bit* or *extremely.* Next, each symptom cluster (i.e. criterion B-E) was scored using a binary (yes/no) variable according to the DSM-5 definitions (e.g., at least one symptom from the intrusion symptoms must be reported to meet criterion B). A "provisional PTSD symptoms" (yes/no) variable was created (meeting criteria B to E) using published methods (Weathers et al., 2013). The survey also asked whether they had ever been diagnosed with a mental health disorder by a health professional and which ones (responses included PTSD and Major Depressive Disorder).

ii. Depression symptoms

Depression symptoms were measured using The Revised Center for Epidemiologic Studies Depression 10-item scale (CESD-10) (Andresen, Malmgren, Carter, & Patrick, 1994), a widely used depression symptom screening tool developed from the original 20-item scale (Radloff, 1977). Symptoms were assessed on a 4-point Likert scale (*rarely/none of the time* vs. *some/a little of the time* vs. *occasionally/moderate amount of the time* vs. *most/all of the time*) and the total score ranges from 0-30. Total CESD-10 scores indicating "Depression symptom severity" was calculated. A higher cut-off of 15 or greater was used to indicate moderate to severe symptoms (Bjorgvinsson, Kertz, Bigda-Peyton, McCoy, & Aderka, 2013). A dichotomous variable indicating moderate to severe depression symptoms was constructed for analysis.

iii. Sexual and physical violence

Items are derived from the Revised Conflict Tactics Scale (Straus, Hamby, Boney-McCoy, & Sugarman, 1996), a widely used scale designed for capturing intimate partner violence that has been used in previous sex work research, including our own work (Brantley, Kerrigan, German, Lim, & Sherman, 2017; Decker et al., 2017). Childhood sexual violence (CSV) was defined as pressured or forced sexual intercourse or sexual touching. Adulthood sexual violence (ASV) was defined as physically forced sexual intercourse perpetrated by intimate partners, sex work clients, pimps/managers (if applicable) or police officers. Childhood physical violence (CPV) encompassed being hit, punched, slapped or otherwise physically hurt by someone; adulthood physical violence (APV) included this definition and being threatened or hurt with a weapon. A global binary

variable ("any lifetime violence"; yes/no) indicated reporting at least one form of violence (i.e., CSV, ASV, CPV or APV). A "Cumulative violence" variable was constructed using the total sum of lifetime violence forms experienced.

iv. Opioid and cocaine use

Other survey measures were developed from previous work (Brantley, Footer, Lim, Kerrigan, & Sherman, 2017; Brantley, Kerrigan, et al., 2017; Decker et al., 2017). Frequency of substance use was measured using pre-defined drug type categories, which included *daily* as the most frequent use option. Opioids were defined as heroin or misuse of "prescription pain killers such as Percocet, Morphine, OxyContin, Codeine, Fentanyl but not over the counter pills" Cocaine included use of crack or powder cocaine.

v. Binge drinking

The Alcohol Use Disorders Identification Test (AUDIT-C) is a validated brief (3-item) screening scale developed by the World Health Organization for assessing alcohol disorders (scores range from 0-16) (WHO, 2001). A daily/almost daily binge drinking binary variable was constructed from the item "How often did you have four or more drinks on one occasion in the past year?" where daily/almost daily was a response option.

Data analysis

This analysis only included FSW who were assigned as female at birth (i.e. cisgender females) who completed the PCL-5 (N=230). We calculated mean age and the prevalence of socio-demographic, violence, mental health and substance use and

characteristics of the sample. We reported the prevalence of co-occurring violence, depression, homelessness and substance use with PTSD as well as the median number of co-occurring conditions for each individual.

For each PCL-5 scale item, and overall CESD-10 and AUDIT-C scales, we described the mean, standard deviation, variance, skewness, kurtosis and range. We used the Shapiro-Wilk test to test the hypothesis that the sample was derived from a normally distributed population (with $p<0.05$ indicating statistical significance). We calculated Cronbach's alpha for the PCL-5 (total scale and each cluster) to measure internal consistency. The multivariate normal assumption for the PCL-5 was examined using an omnibus test for multivariate normality and was rejected indicating a non-normal multivariate distribution ($p<0.001$) (Baum & Cox, 2007). The same procedures were conducted for the overall CESD-10 and AUDIT-C scales. In order to examine convergent and divergent validity, Pearson's correlation coefficients comparing the PCL-5 (total scale and each cluster) to the CESD-10 and AUDIT-3 were also computed.

Previous psychometric research has yielded a number of PTSD factor structures, including the four-factor DSM-5 model (Blevins et al., 2015) and five-factor Dysphoric Arousal (Armour et al., 2015). Parallel analysis of the PCL-5 data was run to determine the optimal number of factors to be tested in factor analysis.

Factor analysis were conducted using Mplus 7.0 (Muthén & Muthén, 1998-2012). First, we conducted exploratory factor analysis (EFA) and extracted one to five factors using three estimators: Maximum Likelihood (ML), Robust Maximum Likelihood (MLR), and Weighted Least Squares Means and Variance Adjusted (WLSMV) estimation. A promax rotation was used to account for oblique factors (Costello & Osborne, 2005). The

factor loadings and uniqueness were examined for all four models as well as model fit using the Root Mean Square Error of Approximation (RMSEA). Adequate fit was assessed using established cut-offs: RMSEA<0.1.

In confirmatory factor analyses, we tested four published factor models for the PCL-5: one factor, the DSM-IV (three factor) model, the DSM-5 (four factor) model and the DSM-IV dysphoric arousal (five factor) model. The PCL-5 scale indicators have been treated as ordinal and continuous in the literature. Accordingly, two estimators from the EFA were compared: In the first set of models, WLSMV estimation was used, which treated variables as ordinal. In the second set of models, MLR estimation was used and standard errors computed using a sandwich estimator, which treated the variables as continuous. Factors were correlated and factor variances were set to 1. Model fit was assessed using the goodness-of-fit chi-squared test of model fit, the RMSEA, the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Standardized Root Mean Square Residual (SRMR), AIC and BIC statistics (the latter three are only applicable for MLR). RMSEA<0.1 reflects good fit and <0.05 indicates very good fit (Steiger 1989); SRMR<0.05 indicates good fit, CFI>0.95 and TLI>0.95 reflect excellent fit.

DSM-5 diagnostic cluster patterns were described by grouping individuals based on their cluster patterns. The total prevalence of endorsing (i.e. endorsing moderate to severe symptoms according to DSM-5 thresholds) each cluster was reported. Lastly, we examined the age-adjusted associations between violence indicators (CSV, CPV, ASV, APV, and cumulative violence) and each binary PTSD cluster variable using Poisson regression models with robust variance to approximate binomial regression to estimate

prevalence rate ratios (PrR) (Zou, 2004). All descriptive, exploratory and regression analysis were conducted in Stata/SE 14.2 (College Station, Texas).

Results

As shown in **Table 1**, sample age ranged from 18-61 years and the mean age was 36 years (SD=9); half (51%) did not complete high school, 62% were homeless in the past 3 months and 65% engaged in sex work seven days a week. The sample was mostly Non-Hispanic White (66%), followed by Non-Hispanic Black (23%) and Hispanic/Other (11%) (data not shown). Experiences of lifetime violence were common (82%). Thirty-five percent experienced CSV and 43% experienced CPV. The prevalence of ASV and APV were 40% and 72% respectively. Clients and intimate partners perpetrated the majority of the violence during adulthood (67% and 70% respectively) followed by police (36%) (data not shown).

Sixty-one percent of the sample experienced moderate to high levels of PTSD symptoms (**Table 1**). Among FSW who screened PTSD-positive (PCL-5≥33), 85% met DSM-5 criteria for PTSD symptoms, and 23% had been previously diagnosed with PTSD by a healthcare provider. Most (64%) had depression symptoms (CESD-10≥15) but of these women, half (53%) had been diagnosed. Daily substance use was prevalent and frequent with the majority of women using heroin and/or cocaine (86%), and 9% engaging in daily or almost daily binge drinking.

Conditions that commonly co-occurred with PTSD are shown in **Table 2**. Co-occurrence between PTSD symptoms and lifetime violence, depression and heroin/cocaine use among the full sample was 40-61%. Co-occurring PTSD and binge drinking affected 10% of the sample.

Table 3 shows descriptive statistics on the PCL-5, CESD-10 and AUDIT-C. PTSD symptoms that were most severe on average were as follows: "feeling distant or cut off from other people" (D6), "being superalert or watchful or on guard" (E3), "trouble falling or staying asleep" (E6) and "taking too many risks or doing things that could cause you harm" (E2). Symptoms with the lowest averages were "suddenly feeling or acting as if the stressful experience were actually happening again" (B3), "trouble remembering important parts of the stressful experience" (D1) and "repeated, disturbing dreams of the stressful experience" (B2). Overall, the data were negatively skewed. The overall PCL-5 and each symptom cluster demonstrated high internal consistency (α=0.89-0.96). The CESD-10 and AUDIT-C also had high internal consistency (α=0.82 and α=0.89 respectively).

Correlations between PCL-5, CESD-10 and AUDIT-3 are displayed in **Table 4**. PCL-5 clusters had moderate to strong correlations with the highest correlations observed between clusters D and E (r=0.84). Cluster D held the strongest correlation with the total PCL-5 score (r=0.94). Correlations between PCL-5 scale and the CESD-10 and AUDIT-3 were moderate and low respectively, which signaled convergent and discriminant validity of the PCL-5.

Exploratory factor analysis (N=230) revealed that three, four and five factor models had adequate fit after treating indicators as either ordinal (WLSMV) or continuous (MLR) (RMSEA=0.076-0.097) (data not shown). The multivariate normality assumption was rejected (p<0.001). Ordinal indicator models produced less item residual variance than continuous indicator models. Based on these findings, we decided to test the three, four and five factor models in CFA using WLSMV. PCL-5 item 8 (D1; amnesia) had high (>0.5) residual variance in the three and four factor ordinal models whereas in the continuous

models, item 8, 17 (E3; hypervigilance) and 20 (E6; sleep) had high residual variance. In the four and five factor ordinal models, we also observed low loadings for item 8 and cross loadings for item 11 (D4; negative feelings) and 17. Models with six or seven factors failed to produce acceptable loadings (>0.4) on one or more factors (WLSMV estimator) or failed to converge (MLR) (data not shown).

Item mappings for the four models examined using CFA (N=230) are located in **Table 5**. Overall, the CFA revealed that the DSM-5 model with ordinal indicators had better model fit than the continuous indicator models thus the WLSMV estimator was used (data not shown). The four factor (DSM-V; RMSEA=0.094, CFI=0.973, TLI=0.968) and five factor (DSM-IV dysphoric arousal; RMSEA=0.093, CFI=0.974, TLI=0.969) models performed similarly well whereas the one factor (RMSEA=0.16, CFI=0.918, TLI=0.909) and three factor (DSM-IV; RMSEA=0.133, CFI=0.945, TLI=0.937) models had RMSEA values that failed to meet the cut-off for adequate fit.

The factor loadings, residuals and factor correlations for the DSM-5 model are displayed in **Figure 2**. All items loaded strongly to each respective factor (>0.75) with the exception of items 8 (D1; amnesia), 17 (E3; hypervigilance) and 20 (E6; sleep), which had loadings ranging from 0.696-0.720. Nevertheless, all factor loadings were statistically significant (p<0.001).

As shown in **Table 6**, over half (56%) endorsed symptoms in all four DSM-5 PTSD clusters, 28% were subsyndromal (endorsed 1 to 3 clusters) and 17% did not endorse any clusters. The average of the individual means for cluster B, C, D and E was 1.65 (SD=1.20), 2.13 (SD=1.39), 1.91 (SD=1.22) and 2.17 (SD=1.21) respectively. Excluding cluster D the Anhedonia cluster (which has been suggested for removal from the PTSD

DSM criteria due to substantial overlap with symptoms in Major Depressive Disorder) accounted for a difference in PTSD prevalence of 4%.

The Poisson regression analyses (N=220) that examined associations between DSM-5 PTSD diagnostic clusters and each violence type as well as cumulative violence are located in **Table 7**. All four violence indicators (i.e., CSV, CPV, ASV, APV) were significantly associated with each PTSD symptom cluster ($p<0.05$). In the cumulative violence models, experiencing two, three or four types of violence were each significantly associated with all four PTSD symptom clusters (cluster B, C, D, E), compared to no lifetime violence reference group; overall, a dose-response relationship was observed ($p<0.05$). Reporting only one violence type (vs. none) was not significantly associated with exhibiting any of the symptom clusters ($p>0.05$).

Discussion

This study is among one of the first to examine the phenomenologic and psychometric characteristics of PTSD symptoms among street-based FSW. Among this socially and structurally vulnerable population, we found high levels of PTSD, assaultive violence and comorbidity. Sixty-one percent of FSW exhibited PTSD symptoms, most of whom had never been clinically diagnosed. Our analysis of the PTSD symptom cluster patterns elucidated that while about half met symptom criteria DSM-5 PTSD (i.e. in all four clusters), more than a quarter (28%) had subsyndromal PTSD. High co-occurrence (40-51%) was observed between PTSD and exposure to violence, depression, homelessness and drug use, and most FSW had multiple comorbidities. Factor analysis provides novel insights into the psychometric properties of the PCL-5 for assessing PTSD among women exposed to high levels of sexual and physical violence and re-victimization.

These data underscore the urgent need for improved access to effective, integrated and trauma-informed mental health services among FSW that is non-stigmatizing and sensitive to their needs.

The prevalence of PTSD and violence among our sample was high and consistent with the few published studies of PTSD among sex workers (Farley et al., 2004; Roxburgh et al., 2006). PTSD prevalence was several times higher in this study than that observed among studies of U.S. military veterans and treatment seeking intimate partner violence victims that also used the PCL-5 (Hoge et al., 2014). The mean PCL-5 score and symptom cluster profiles among FSW in our study were comparable to that observed in a study of a majority-male military sample who were seeking mental health treatment (Wortmann et al., 2016). Further research will be required to examine the complex relationships between victimization and health needs among FSW. Future studies that adopt methods that better account for the presence of comorbidities rather than attempting to model "independent" cross-sectional correlates as we did in the current study may yield more nuanced findings.

The high comorbidity between PTSD and current daily drug use is concerning; this specific comorbidity is known to increase the risk of other mental health and related comorbidities, and result in poorer treatment outcomes among patients (Flanagan et al., 2016). For example, the clinical options for patients who present with comorbid PTSD and SUD are currently limited and clinicians may prescribe consecutive treatment rather than concurrent, integrated treatment despite the preferences of the patient (Roberts, Roberts, Jones, & Bisson, 2015). Substance use has a central role in these women's lives; women often enter street-based sex work to support their drug use, and use drugs and alcohol to chemically dissociate from the day-to-day challenges of sex work (Dalla, 2002;

John J Potterat, Rothenberg, Muth, Darrow, & Phillips- Plummer, 1998; Sherman, Lilleston, & Reuben, 2011). Previous studies also show that substance use may increase vulnerability to violence, which may exacerbate PTSD symptoms (El-Bassel, Gilbert, Witte, Wu, & Chang, 2011). Providers should be aware that the risk of re-victimization is high among FSW and proactively engage and empower FSW to adopt appropriate safety and prevention strategies (Chamberlain & Levenson, 2012); this is in part because the stigmatization and criminalization of sex work poses difficulties for achieving legal protection, for example, reporting a violent encounter may result in arrest. Frequent incarceration for sex work and drug use may trigger PTSD and also pose severe difficulties for retention in care. Fear of arrest may also reduce the likelihood of accessing healthcare services thus maintaining trust, professionalism and confidentiality is critical for engaging FSW into care (Kurtz, Surratt, Kiley, & Inciardi, 2005). Future mental health services targeting these women should be integrated, trauma-informed and culturally sensitive to the stigma and other realities surrounding sex work.

There has been debate in the literature on the utility of the current four-factor diagnostic criteria for PTSD in screening and treating patients. Similar tensions were observed in our study; both the four-factor DSM-5 model and DSM-IV Dysphoric Arousal model had excellent fit according to CFI and TLI statistics. The four-factor model missed almost 30% of subsyndromal cases who exhibited moderate to severe PTSD symptoms within one, two or three PTSD symptom clusters. In this study, we also observed high correlation between the PCL-5 cluster D (negative cognitions and mood) and depression levels (measured using the CESD-10). One remedy suggested in the literature would be to exclude cluster D from DSM PTSD criteria; in this study, this modification would lead to

an increase in PTSD symptom prevalence of 4%, which means that removal of this cluster alone may not appear to solve the issue. Exploratory factor analysis suggested that the amnesia item loaded poorly within cluster D (negative cognition or mood), which using face validity is intuitive given the self-reported nature of the PCL-5 and could be considered for re-categorization or removal. Also notable were the relatively lower loadings of scale items on hypervigilance and sleep, factors likely influenced by substance use but also the nature of street-based sex work and homelessness where the risk of violence is endemic and sleep may be compromised by the need to work unconventional hours and relocate based on local policing strategies.

This research is subject to several limitations. In order to reduce cognitive burden, the DSM-5 criterion A i.e. the "single worst trauma" was not measured using a traumatic life events scale in this study. Instead, we chose to comprehensively measure sexual and physical violence due to the prominence of these experiences in the lives of FSW, including perpetrated by clients, police, family and intimate partners. Participants were not clinically diagnosed in this study, however, were referred to care. It is plausible that many of their trauma histories, symptom patterns and personality profiles better fit complex trauma rather than DSM-5 defined PTSD (Herman, 2015). The PCL-5 cut-off used to examine the prevalence of comorbidities was originally validated among veterans. Using a continuous PCL-5 score may be more appropriate when modelling PTSD in non-veteran populations rather than the cut-off (binary variable). Future studies should also examine the role of psychological trauma in the lives of FSW.

Despite their vulnerability, FSW have historically been an underrepresented population in the modern mental health literature. This study is one of the first to document

the prevalence of PTSD and the extent of violence and comorbidities among street-based FSW in an urban U.S. setting. We used the recently released PCL-5, which held high internal consistency and fit a four factor (DSM-5) structure in confirmatory factor analysis. The PCL-5 appears to be a valid and acceptable self-reported measure among street-based FSW. Our results demonstrate that recognition of the role of accumulated exposure to violence from a range of perpetrators and throughout the life course, the impact of substance use and realities of sex work will be helpful in informing clinical practice and future prevention and treatment efforts for this vulnerable population.

Table 1: Characteristics of female sex workers in Baltimore, Maryland (N=230)

Variable	n	%
Socio-demographics		
Age, Mean (SD)	36	(9)
Did not complete high school	118	51.3
Homelessness, past 3 months	143	62.2
Worked seven days a week	149	64.8
Violence (n=220)		
Any	180	81.8
Childhood		
Sexual violence*	77	35.0
Physical violence**	94	42.7
Adulthood^		
Sexual violence*	87	39.6
Physical violence**	159	72.3
Mental health		
PTSD symptoms (PCL-5 ≥ 33)	141	61.3
Provisional DSM-5 PTSD symptoms (PCL-5)	120	85.1
Ever diagnosed with PTSD by a provider	32	22.7
Depression symptoms (CESD-10 ≥ 15) (n=225)	144	64.0
Ever diagnosed with MDD by a provider	76	52.8
Substance use#		
Daily opioid use (e.g. heroin, opioid pills)	170	73.9
Daily cocaine use	147	63.9
Daily opioid or cocaine use	197	85.7
Daily or almost daily binge drinking	22	9.6

Not as prescribed by a doctor or nurse
*forced vaginal or anal sexual intercourse (childhood also includes sexual touching and pressured sex)
**hit, punched, slapped or otherwise physically hurt (adulthood also includes being threatened with a weapon)
^ Intimate partners, clients, pimps/managers, police

Table 2: Percent of full FSW sample (N=230) with PTSD symptoms and co-occurring violence, depression, homelessness and substance use

	N	%
Total	230	100.0
Co-occurring PTSD symptoms and...		
….Lifetime violence	122	54.7
….Depression symptoms (CESD-10 ≥ 15)	115	51.1
….Homeless, past 3 months	94	40.9
….Daily opioid use	106	46.1
….Daily cocaine use	91	39.6
….Daily or almost daily binge drinking	16	7.0
Number of co-occurrences (median)	3	-

Table 3: Descriptive statistics on the PCL-5, CESD-10 and AUDIT-C

Variable (possible range)	Mean	SD	Variance	Skew	Kurtosis	Normality* (p-value)	Range (min)	Range (max)	Cronbach 's alpha
PCL-5 item (0-4)									
B1	1.83	1.43	2.03	0.21	1.71	0.053	0	4	--
B2	1.49	1.36	1.85	0.52	2.07	**0.005**	0	4	--
B3	1.28	1.36	1.85	0.72	2.24	**<0.001**	0	4	--
B4	1.90	1.42	2.01	0.09	1.73	0.684	0	4	--
B5	1.76	1.40	1.96	0.15	1.76	0.448	0	4	--
C1	2.19	1.44	2.07	-0.20	1.69	0.141	0	4	--
C2	2.08	1.45	2.11	-0.14	1.65	0.098	0	4	--
D1	1.31	1.37	1.89	0.71	2.22	**<0.001**	0	4	--
D2	1.76	1.51	2.28	0.30	1.64	**0.013**	0	4	--
D3	1.76	1.52	2.30	0.28	1.60	**0.006**	0	4	--
D4	1.93	1.50	2.24	0.12	1.59	0.08	0	4	--
D5	2.24	1.47	2.17	-0.18	1.60	0.067	0	4	--
D6	2.32	1.52	2.30	-0.32	1.61	**0.006**	0	4	--
D7	2.02	1.54	2.37	-0.03	1.50	**0.034**	0	4	--
E1	2.02	1.54	2.37	0.01	1.49	**0.028**	0	4	--
E2	2.29	1.53	2.35	-0.30	1.59	**0.011**	0	4	--
E3	2.31	1.47	2.15	-0.28	1.68	0.103	0	4	--
E4	1.92	1.48	2.20	0.11	1.61	0.153	0	4	--
E5	2.16	1.49	2.23	-0.12	1.56	**0.042**	0	4	--
E6	2.31	1.50	2.26	-0.27	1.61	**0.043**	0	4	--

Table 3: Descriptive statistics on the PCL-5, CESD-10 and AUDIT-C (cont'd)

Variable (possible range)	Mean	SD	Variance	Skew	Kurtosis	Normality* (p-value)	Range (min)	Range (max)	Cronbach 's alpha
PCL-5 total (0-80)	38.83	21.83	476.41	-0.06	2.05	**0.003**	0	80	0.96
Cluster B: Intrusions (0-20)	8.26	6.01	36.11	0.25	2.07	**0.022**	0	20	0.91
Cluster C: Avoidance (0-8)	4.27	2.79	7.76	-0.18	1.72	**0.023**	0	8	0.92
Cluster D: Negative Cognitions and Mood (0-28)	13.28	8.50	72.26	0.06	1.87	**0.003**	0	28	0.92
Cluster E: Arousal and Reactivity (0-24)	12.99	7.27	52.83	-0.12	1.89	**0.014**	0	24	0.89
CESD-10 total (0-30)	17.43	7.00	48.98	-0.37	2.27	**<0.001**	0	30	0.82
AUDIT-C (0-12)	2.51	3.55	12.58	1.30	3.40	**<0.001**	0	12	0.89

**Shapiro –Wilk test for normality, bolded are p<0.05*

Table 4: Correlations of DSM-5 PTSD symptom clusters, PTSD symptom severity (PCL-5), depression symptoms (CESD-10) and alcohol use (AUDIT-3)

PCL-5 cluster scores	B (Intrusion)	C (Avoidance)	D (Anhedonia)	E (Hyperarousal)	CESD-10 score	AUDIT-3 score
B (Intrusion)					.52	.19
C (Avoidance)	.74				.39	.12
D (Anhedonia)	.70	.66			.64	.18
E (Hyperarousal)	.62	.63	.84		.58	.18
Total PCL-5 score	.85	.79	.94	.91	.63	.20

Table 5: Item mappings for PCL-5 Confirmatory Factor Analysis Models

Item	DSM-5 Cluster	One factor	Three factors (DSM-IV)	Four factors (DSM-5)	Five factors (DSM-IV dysphoric arousal)
	B1	P	R	R	R
2	B2	P	R	R	R
3	B3	P	R	R	R
4	B4	P	R	R	R
5	B5	P	R	R	R
6	C1	P	A/N	A	A
7	C2	P	A/N	A	A
8	D1	P	A/N	NA	N
9	D2	P	A/N	NA	N
10	D3	P	A/N	NA	N
11	D4	P	A/N	NA	N
12	D5	P	A/N	NA	N
13	D6	P	A/N	NA	N
14	D7	P	A/N	NA	N
15	E1	P	H	H	DA
16	E2	P	H	H	DA
17	E3	P	H	H	AA
18	E4	P	H	H	AA
19	E5	P	H	H	DA
20	E6	P	H	H	DA

A=Avoidance cluster; AA=Anxious Arousal cluster; A/N=Avoidance/Numbing cluster; DA=Dysphoric Arousal cluster; H=Hyperarousal cluster; N=Emotional Number; NA=Negative Alterations in Cognitions and Mood (including emotional numbing) cluster; P= PTSD cluster; R=Re-experiencing cluster;

Figure 2: Path diagram of the factor structure of the DSM-5 model (N=230)

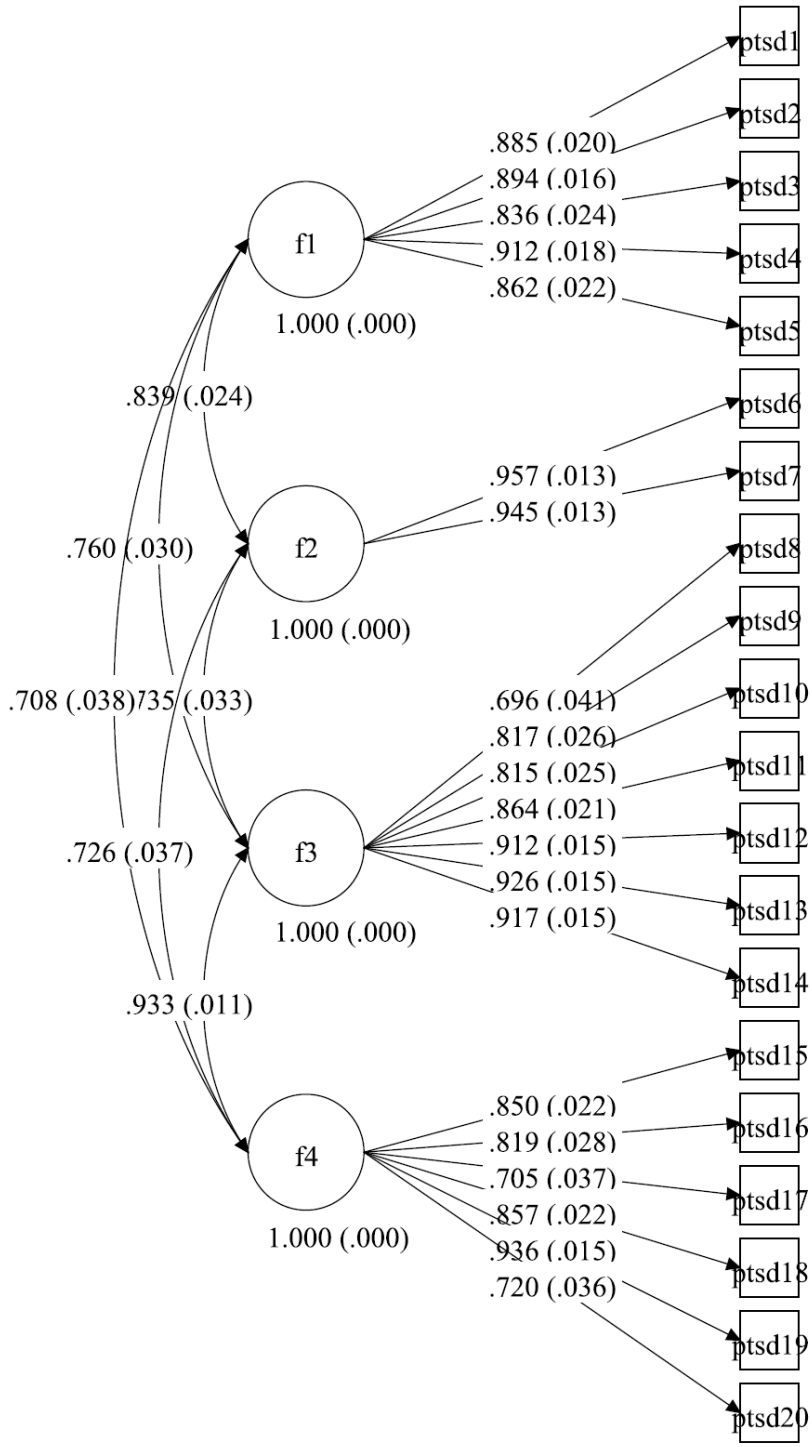


Table 6: Observed DSM-5 PTSD symptom cluster patterns ordered by prevalence among female sex workers in Baltimore, Maryland (N=230)

	DSM-5 Symptom Clusters					
No. of clusters endorsed	**B (Intrusion)**	**C (Avoidance)**	**D (Anhedonia)**	**E (Arousal)**	**n**	**Prevalence (%)**
4*	Y	Y	Y	Y	128	55.7
0	N	N	N	N	38	16.5
3	Y	N	Y	Y	11	4.8
2	N	N	Y	Y	10	4.4
3	Y	Y	N	Y	9	3.9
3	N	Y	Y	Y	6	2.6
1	Y	N	N	N	6	2.6
1	N	N	N	Y	5	2.2
2	Y	Y	N	N	5	2.2
3	Y	Y	Y	N	4	1.7
1	N	Y	N	N	3	1.3
2	N	Y	N	Y	2	0.9
2	N	Y	Y	N	1	0.4
2	Y	N	N	Y	1	0.4
2	Y	N	Y	N	1	0.4
Total who endorsed the cluster (col %)	71.7%	68.7%	70.0%	74.8%	230	

Y=Yes; N=No; *meets DSM-5 symptom criteria for PTSD

Table 7: The age-adjusted relationship between violence and DSM-5 PTSD diagnostic clusters among street-based female sex workers in Baltimore, Maryland (N=220)

	Endorsed Cluster B (Intrusion)		Endorsed Cluster C (Avoidance)		Endorsed Cluster D (Anhedonia)		Endorsed Cluster E (Hyperarousal)	
	Adjusted PrR[#] (95% CI)	p	Adjusted PrR[#] (95% CI)	p	Adjusted PrR[#] (95% CI)	p	Adjusted PrR[#] (95% CI)	p
CSV	1.41 (1.22-1.64)	**<0.001**	1.57 (1.34-1.84)	**0.001**	1.40 (1.20-1.64)	**<0.001**	1.34 (1.17-1.54)	**<0.001**
CPV	1.23 (1.06-1.44)	**0.009**	1.53 (1.29-1.82)	**<0.001**	1.34 (1.14-1.59)	**<0.001**	1.34 (1.16-1.55)	**<0.001**
ASV	1.35 (1.15-1.58)	**<0.001**	1.35 (1.14-1.60)	**<0.001**	1.38 (1.16-1.61)	**<0.001**	1.36 (1.18-1.57)	**<0.001**
APV	1.46 (1.15-1.85)	**0.002**	1.53 (1.18-1.99)	**0.001**	1.45 (1.13-1.86)	**0.003**	1.51 (1.19-1.91)	**0.001**
Cumulative violence								
0	REF		REF		REF		REF	
1	1.19 (0.81-1.76)	0.372	1.41 (0.87-2.28)	0.159	1.10 (0.72-1.69)	0.647	1.13 (0.75-1.68)	0.563
2	1.57 (1.12-2.21)	**0.01**	2.03 (1.33-3.10)	**0.001**	1.76 (1.24-2.49)	**0.002**	1.74 (1.25-2.41)	**0.001**
3	1.76 (1.26-2.45)	**0.001**	2.37 (1.58-3.57)	**<0.001**	1.69 (1.18-2.41)	**0.004**	1.74 (1.25-2.42)	**0.001**
4	1.95 (1.42-2.68)	**<0.001**	2.59 (1.73-3.87)	**<0.001**	2.03 (1.45-2.85)	**<0.001**	2.00 (1.47-2.73)	**<0.001**

Note: Poisson regression with robust variance adjusted for age used to model prevalence ratios.

[#]Reference group = did not experience that form of violence

ASV = adulthood sexual violence; APV = adulthood physical violence; CSV = childhood sexual violence; CPV = childhood physical violence; CI = confidence intervals; DSM-5 = Diagnostic and statistical manual of mental disorders REF = reference group; PrR = prevalence ratios; PTSD = Posttraumatic Stress disorder

References

Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D. *American journal of preventive medicine*.

Armour, C., Tsai, J., Durham, T. A., Charak, R., Biehn, T. L., Elhai, J. D., & Pietrzak, R. H. (2015). Dimensional structure of DSM-5 posttraumatic stress symptoms: support for a hybrid Anhedonia and Externalizing Behaviors model. *J Psychiatr Res, 61*, 106-113.

Baum, C. F., & Cox, N. J. (2007). *Omninorm: Stata module to calculate omnibus test for univariate / multivariate normality.* Retrieved from http://ideas.repec.org/c/boc/bocode/s417501.html

Bjorgvinsson, T., Kertz, S. J., Bigda-Peyton, J. S., McCoy, K. L., & Aderka, I. M. (2013). Psychometric properties of the CES-D-10 in a psychiatric sample. *Assessment, 20*(4), 429-436.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *J Trauma Stress, 28*(6), 489-498.

Bonanno, G. A., Mancini, A. D., Horton, J. L., Powell, T. M., Leardmann, C. A., Boyko, E. J., . . . Millennium Cohort Study, T. (2012). Trajectories of trauma symptoms and resilience in deployed U.S. military service members: prospective cohort study. *Br J Psychiatry, 200*(4), 317-323.

Bovin, M. J., Marx, B. P., Weathers, F. W., Gallagher, M. W., Rodriguez, P., Schnurr, P. P., & Keane, T. M. (2016). Psychometric properties of the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5) in veterans. *Psychol Assess, 28*(11), 1379-1391.

Brantley, M. L., Footer, K. H. A., Lim, S., Kerrigan, D., & Sherman, S. G. (2017). Experiences of structural vulnerability among exotic dancers in Baltimore, Maryland: Co-occurring social and economic antecedents of HIV/STI risk. *Int J Drug Policy, 50*, 74-81.

Brantley, M. L., Kerrigan, D., German, D., Lim, S., & Sherman, S. G. (2017). Identifying Patterns of Social and Economic Hardship Among Structurally Vulnerable Women: A Latent Class Analysis of HIV/STI Risk. *AIDS Behav, 21*(10), 3047-3056.

Bremner, J. D. (1999). Acute and chronic responses to psychological trauma: where do we go from here? *American Journal of Psychiatry, 156*(3), 349-351.

Breslau, N., Kessler, R. C., Chilcoat, H. D., Schultz, L. R., Davis, G. C., & Andreski, P. (1998). Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of general psychiatry, 55*(7), 626-632.

Brewin, C. R., Andrews, B., & Valentine, J. D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol, 68*(5), 748-766.

Chamberlain, L. & Levenson, R. (2012). *A guide for obstetric, gynecologic and reproductive health care settings.* Futures Without Violence.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical assessment, research & evaluation, 10*(7), 1-9.

Dalla, R. L. (2002). Night moves: A qualitative investigation of street-level sex work. *Psychology of Women Quarterly, 26*(1), 63-73.

Decker, M. R., Crago, A. L., Chu, S. K., Sherman, S. G., Seshu, M. S., Buthelezi, K., . . . Beyrer, C. (2015). Human rights violations against sex workers: burden and effect on HIV. *Lancet, 385*(9963), 186-199.

Decker, M. R., Nail, J. E., Lim, S., Footer, K., Davis, W., & Sherman, S. G. (2017). Client and Partner Violence Among Urban Female Exotic Dancers and Intentions for Seeking Support and Justice. *J Urban Health, 94*(5), 637-647.

Decker, M. R., Pearson, E., Illangasekare, S. L., Clark, E., & Sherman, S. G. (2013). Violence against women in sex work and HIV risk implications differ qualitatively by perpetrator. *BMC Public Health, 13*, 876.

Deering, K. N., Amin, A., Shoveller, J., Nesbitt, A., Garcia-Moreno, C., Duff, P., . . . Shannon, K. (2014). A systematic review of the correlates of violence against sex workers. *Am J Public Health, 104*(5), e42-54.

El-Bassel, N., Gilbert, L., Witte, S., Wu, E., & Chang, M. (2011). Intimate partner violence and HIV among drug-involved women: contexts linking these two epidemics—challenges and implications for prevention and treatment. *Substance use & misuse, 46*(2-3), 295-306.

Erausquin, J. T., Reed, E., & Blankenship, K. M. (2011). Police-related experiences and HIV risk among female sex workers in Andhra Pradesh, India. *J Infect Dis, 204 Suppl 5*, S1223-1228.

Farley, M., Cotton, A., Lynne, J., Zumbeck, S., Spiwak, F., Reyes, M. E., . . . Sezgin, U. (2004). Prostitution and trafficking in nine countries: An update on violence and posttraumatic stress disorder. *Journal of Trauma Practice, 2*(3-4), 33-74.

Flanagan, J. C., Korte, K. J., Killeen, T. K., & Back, S. E. (2016). Concurrent Treatment of Substance Use and PTSD. *Curr Psychiatry Rep, 18*(8), 70.

Hedtke, K. A., Ruggiero, K. J., Fitzgerald, M. M., Zinzow, H. M., Saunders, B. E., Resnick, H. S., & Kilpatrick, D. G. (2008). A longitudinal investigation of interpersonal violence in relation to mental health and substance use. *Journal of Consulting and Clinical Psychology, 76*(4), 633.

Herman, J. L. (2015). *Trauma and recovery: The aftermath of violence--from domestic abuse to political terror*: Hachette UK.

Hoge, C. W., Riviere, L. A., Wilk, J. E., Herrell, R. K., & Weathers, F. W. (2014). The prevalence of post-traumatic stress disorder (PTSD) in US combat soldiers: a head-to-head comparison of DSM-5 versus DSM-IV-TR symptom criteria with the PTSD checklist. *Lancet Psychiatry, 1*(4), 269-277.

Hong, Y., Zhang, C., Li, X., Liu, W., & Zhou, Y. (2013). Partner violence and psychosocial distress among female sex workers in China. *PLoS One, 8*(4), e62290.

Hutton, H. E., Treisman, G. J., Hunt, W. R., Fishman, M., Kendig, N., Swetz, A., & Lyketsos, C. G. (2001). HIV risk behaviors and their relationship to posttraumatic stress disorder among women prisoners. *Psychiatr Serv, 52*(4), 508-513.

Inciardi, J. A., & Surratt, H. L. (2001). Drug use, street crime, and sex-trading among cocaine-dependent women: implications for public health and criminal justice policy. *J Psychoactive Drugs, 33*(4), 379-389.

Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry, 62*(6), 617-627.

Kurtz, S. P., Surratt, H. L., Kiley, M. C., & Inciardi, J. A. (2005). Barriers to health and social services for street-based sex workers. *J Health Care Poor Underserved, 16*(2), 345-361.

Ozer, E. J., Best, S. R., Lipsey, T. L., & Weiss, D. S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychol Bull, 129*(1), 52-73.

Potterat, J. J., Brewer, D. D., Muth, S. Q., Rothenberg, R. B., Woodhouse, D. E., Muth, J. B., . . . Brody, S. (2004). Mortality in a long-term open cohort of prostitute women. *Am J Epidemiol, 159*(8), 778-785.

Potterat, J. J., Rothenberg, R. B., Muth, S. Q., Darrow, W. W., & Phillips- Plummer, L. (1998). Pathways to prostitution: The chronology of sexual and drug abuse milestones. *Journal of Sex Research, 35*(4), 333-340.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement, 1*(3), 385-401.

Renshaw, K. D., Campbell, S. B., Meis, L., & Erbes, C. (2014). Gender differences in the associations of PTSD symptom clusters with relationship distress in U.S. Vietnam veterans and their partners. *J Trauma Stress, 27*(3), 283-290.

Rhodes, T., Simic, M., Baros, S., Platt, L., & Zikic, B. (2008). Police violence and sexual risk among female and transvestite sex workers in Serbia: qualitative study. *BMJ, 337*, a811.

Roberts, N. P., Roberts, P. A., Jones, N., & Bisson, J. I. (2015). Psychological interventions for post-traumatic stress disorder and comorbid substance use disorder: A systematic review and meta-analysis. *Clinical psychology review, 38*, 25-38.

Rossler, W., Koch, U., Lauber, C., Hass, A. K., Altwegg, M., Ajdacic-Gross, V., & Landolt, K. (2010). The mental health of female sex workers. *Acta Psychiatr Scand, 122*(2), 143-152.

Roxburgh, A., Degenhardt, L., & Copeland, J. (2006). Posttraumatic stress disorder among female street-based sex workers in the greater Sydney area, Australia. *BMC Psychiatry, 6*, 24.

Rytwinski, N. K., Scur, M. D., Feeny, N. C., & Youngstrom, E. A. (2013). The co-occurrence of major depressive disorder among individuals with posttraumatic stress disorder: a meta-analysis. *J Trauma Stress, 26*(3), 299-309.

Santiago, P. N., Ursano, R. J., Gray, C. L., Pynoos, R. S., Spiegel, D., Lewis-Fernandez, R., . . . Fullerton, C. S. (2013). A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. *PLoS One, 8*(4), e59236.

Shannon, K., Strathdee, S. A., Goldenberg, S. M., Duff, P., Mwangi, P., Rusakova, M., . . . Boily, M. C. (2015). Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet, 385*(9962), 55-71.

Sherman, S. G., Footer, K., Illangasekare, S., Clark, E., Pearson, E., & Decker, M. R. (2015). "What makes you think you have special privileges because you are a police officer?" A qualitative exploration of police's role in the risk environment of female sex workers. *AIDS Care, 27*(4), 473-480.

Sherman, S. G., Lilleston, P., & Reuben, J. (2011). More than a dance: the production of sexual health risk in the exotic dance clubs in Baltimore, USA. *Soc Sci Med, 73*(3), 475-481.

Shnaider, P., Vorstenbosch, V., Macdonald, A., Wells, S. Y., Monson, C. M., & Resick, P. A. (2014). Associations between functioning and PTSD symptom clusters in a dismantling trial of cognitive processing therapy in female interpersonal violence survivors. *J Trauma Stress, 27*(5), 526-534.

Straus, M. A., Hamby, S. L., Boney-McCoy, S., & Sugarman, D. B. (1996). The revised conflict tactics scales (CTS2) development and preliminary psychometric data. *Journal of family issues, 17*(3), 283-316.

Surratt, H. L., Kurtz, S. P., Chen, M., & Mooss, A. (2012). HIV risk among female sex workers in Miami: the impact of violent victimization and untreated mental illness. *AIDS Care, 24*(5), 553-561.

Surratt, H. L., Kurtz, S. P., Weaver, J. C., & Inciardi, J. A. (2005). The Connections of Mental Health Problems, Violent Life Experiences, and the Social Milieu of the "Stroll" with the HIV Risk Behaviors of Female Street Sex Workers. *Journal of Psychology & Human Sexuality, 17*(1-2), 23-44.

Vanwesenbeeck, I. (2001). Another decade of social scientific work on sex work: a review of research 1990-2000. *Annu Rev Sex Res, 12*, 242-289.

Walsh, K., Danielson, C. K., McCauley, J. L., Saunders, B. E., Kilpatrick, D. G., & Resnick, H. S. (2012). National prevalence of posttraumatic stress disorder among sexually revictimized adolescent, college, and adult household-residing women. *Arch Gen Psychiatry, 69*(9), 935-942.

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). The PTSD Checklist for DSM-5 (PCL-5). . Retrieved from doi:Scale available from the National Center for PTSD at www.ptsd.va.gov.

White, J., Pearce, J., Morrison, S., Dunstan, F., Bisson, J. I., & Fone, D. L. (2015). Risk of post-traumatic stress disorder following traumatic events in a community sample. *Epidemiol Psychiatr Sci, 24*(3), 249-257.

World Health Organization (2001). The Alcohol Use Disorders Identification Test: Guidelines for use in primary care. Retrieved from https://www.hepatitis.va.gov/provider/tools/audit-c.asp#S2X

Wortmann, J. H., Jordan, A. H., Weathers, F. W., Resick, P. A., Dondanville, K. A., Hall-Clark, B., . . . Litz, B. T. (2016). Psychometric analysis of the PTSD Checklist-5 (PCL-5) among treatment-seeking military service members. *Psychol Assess, 28*(11), 1392-1403.

Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol, 159*(7), 702-706.

CHAPTER THREE: MANUSCRIPT TWO

Revictimization, cumulative violence and PTSD in the context of chronic strain and substance use among street-based female sex workers

Abstract

Globally, women experience higher levels of PTSD burden than men. Female sex workers (FSW) are a highly marginalized population of women at high-risk of exposure to violence both in their work environment and private lives. However, research on FSW health in the U.S. remains scarce.

The aims of this study were to: (1) Characterize the dimensions of childhood and adulthood violence among street-based FSW, including violence type (sexual and physical), patterns over the life course, key perpetrator groups, revictimization and polyvictimization; (2) Examine the cross-sectional relationship between PTSD severity and two exposures (revictimization and cumulative violence) in the presence of co-occurring chronic strain and substance use factors. Data were drawn from the SAPPHIRE cohort, which recruited street-based FSW in Baltimore, Maryland from 2016 to 2017. Age-adjusted bivariate and multivariate linear regressions with variance clustering to account for clustering by recruitment zone were used to model the associations.

Among our FSW sample (N=230), median PTSD severity was 41. The vast majority (81%) of the sample had a history of sexual or physical violence that was mostly perpetrated by men. Sexual and physical revictimization (i.e. childhood and adulthood) was high at 15% and 38% respectively. The prevalence of revictimization (i.e. by multiple perpetrators) was 19% and 26% for childhood sexual and physical violence, and 33% and 54% for adulthood sexual and physical violence respectively. Most (74%) engaged in daily

opioid use and 10% reported binge drinking on a daily/almost daily basis. In multivariate analysis, exposure to childhood and adulthood sexual violence were associated with higher PTSD severity ($p<0.05$), with marginal associations observed for physical violence. No association for revictimization was observed. In the second multivariate model, cumulative violence was associated with higher PTSD severity ($p<0.05$). Binge drinking was associated with higher PTSD severity in both multivariable models ($p<0.05$).

The levels of PTSD observed among FSW were comparable to that reported among treatment-seeking military veterans. We also documented extensive interpersonal violence histories among these women. These findings underscore the urgent need for effective and tailored trauma-informed mental health interventions among street-based FSW, a population vulnerable to PTSD, gender-based violence, chronic strain and substance use.

Introduction

Violence against women and girls remains a pressing public health issue globally; more than one in three women have been exposed to sexual or physical violence in their lifetime, mostly perpetrated by male intimate partners.[1] Exposure to violence often starts early; among U.S. women, 42% of completed rapes occurred during childhood.[2] In the U.S., one in four women have experienced intimate partner violence (IPV), half of whom exhibit symptoms of posttraumatic stress disorder (PTSD).[2] Women are twice as likely to develop PTSD compared to men at the population-level, are more likely to be exposed to sexual violence, and are at higher risk of developing PTSD following exposure to interpersonal violence.[3,4] Additionally, sex differences in physiological and cognitive responses to stress, and social gender roles (e.g. reliance on passive coping styles) are some contributing factors that appear to explain the higher observed PTSD burden among women.[5] Among women, PTSD severity has been linked to history of childhood sexual abuse, previous non-sexual assault, perception of life threat during the assault, self-blame and delayed disclosure of the assault.[6,7]

Women who engage in sex work i.e. provide sex for money, drugs, favors or goods, are at heightened risk of violence, stress and substance use in both their work environment and personal lives.[8,9] Globally, between 40-90% of FSW have been exposed to violence in their lifetime.[9] The work environment poses unique challenges to FSW health and safety; in most settings, sex work remains criminalized and highly stigmatized, which renders FSW vulnerable to client and police violence and coercion, and poses major barriers to seeking legal protections and justice following victimization. [8,10] For example, FSW report being thrown out of moving cars, robbed with a weapon, and beaten up while

working.[11-14] Many FSW also are exposed to childhood abuse and IPV.[9,15] Unsurprisingly, the prevalence of mental health issues among FSW are unacceptably high, with PTSD symptom prevalence often greater than 50%.[16,17] Our previous work (manuscript one) has shown that the severity of PTSD symptoms among street-based FSW in Baltimore was comparable to that found among treatment-seeking military veterans.[18]

The need to financially support drug addiction is a common driving factor for entering and continuing sex work among street-based FSW.[19] Violence and substance use appear to be mutually reinforcing conditions; substance use is often used as an avoidant coping mechanism among survivors of assault, which in turn may increase the risk of victimization.[20-22] For example, PTSD is a risk factor for substance use coping in women.[20] Comorbid PTSD and SUD poses additional complications for treatment and prognosis.[23,24] Substance withdrawal may elevate PTSD symptoms; opioid and stimulant use may be dampening PTSD symptoms in the short term, may increase the risk of chronic PTSD.[25]

Deleterious socio-cultural gender norms that tolerate or engender violence against women and structurally disempower women have higher prevalence of gender-based violence.[26,27] The high prevalence of violence against women, and inadequate support and justice provided to victims in most settings are perpetuated by institutional and societal differences in socioeconomic opportunities and longstanding socio-cultural gender norms. Accordingly, FSW are vulnerable to the broader institutional and societal forces that affect the agency of women coined the "Social Structure of Gender".[28] These forces are realized through the following domains: gender-based power dynamics (e.g. between husband and wife), labor inequalities (e.g. job discrimination and lower pay compared to men), "cathexis" (e.g. expectations of femininity or subservience towards men), and "symbolism,

culture and discourse" (e.g. shaming rape victims). These forces reverberate forcefully in FSW interactions with clients and police. Male clients who purchase sex inherently hold more power and are persecuted less than FSW by the criminal justice system in most countries, which renders FSW with less power to negotiate the terms of sex exchange. Police are often exclusively male, and perpetrators of sexual coercion, bribery and violence against FSW.[11,13,29,30] Despite the dangers that FSW face in their work environment, formal and informal economic opportunities for these women, particularly street-based FSW, are limited. The role of their structural vulnerability (e.g. housing and financial needs) has been examined in relation to HIV risk, however its role on mental health is poorly understood.[31,32] Drug and alcohol addiction is another powerful condition that perpetuates engagement in street-based sex work [19,33] and is the most common PTSD co-morbidity.[4]

While almost all humans will experience at least one traumatic event in their lifetime, the majority do not develop clinical PTSD.[34] Among all traumas, interpersonal violence (i.e. sexual and physical violence) results in the highest probability of PTSD among civilians.[3] There is an urgent need to characterize the impact of revictimization (within-type), polyvictimization (between-types) and cumulative violence (accumulation over the lifespan) on the course of PTSD.[35] A national study using data from 2005-2006 has shown that revictimization is associated with higher odds of PTSD in the past 6 months.[36] Given the high rates of violence experienced by FSW from a range of domains, examining accumulated forms of trauma across the lifespan is necessary.[35,37] Examining the impact of interpersonal violence on PTSD severity, alongside "chronic strain" factors (i.e. daily or recurring life stress associated with financial, housing, workplace and interpersonal difficulties) that are important in the etiology of depression and co-occurring

substance use may help our understanding of the etiology of PTSD.[35,38,39] One previous study on the correlates of incident violence among FSW revealed homelessness, inability to access drug treatment, police encounters to be significant.[11]

The aims of this study were to characterize the dimensions of lifetime exposure to sexual and physical violence (i.e. type, lifetime patterns and perpetrator types) and to examine the independent relationships between PTSD severity and revictimization and cumulative violence, both in the context of chronic strain and substance use among street-based FSW in the U.S. context.

Methods

Participants

Data were drawn from the Sex workers And Police Promoting Health In Risky Environments (SAPPHIRE) study, a prospective cohort study of FSW (manuscripts under review). Data were collected in 2016 through 2017. Women aged ≥ 15 years who sold or traded oral, vaginal or anal sex "for money or things like food, drugs or favors", picked up clients on the street or at public places ≥ 3 times in the past 3 months and were willing to undergo HIV and STI testing were eligible. The baseline visit consisted of a 50-minute computer assisted personal interview (CAPI) with a trained interviewer. At the end of the survey, the interviewer offered referrals to local health and social service organizations as appropriate. Respondents were compensated with a pre-paid $70 VISA gift card for completing the baseline visit. The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

i. PTSD symptoms

PTSD symptoms were measured using the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5), a 20-item self-reported scale that asks about symptoms in the past month, with responses for each symptom coded using a 5-point Likert scale (not at all, a little bit, moderately, quite a bit, extremely); overall score can range from 0 to 80 [40]. Total PCL-5 scores indicating "PTSD symptom severity" were computed. The mean, standard deviation (SD), median and interquartile range (IQR) were calculated. Results of our previous psychometric study of the PCL-5 among the SAPPHIRE cohort are available elsewhere; internal consistency was high (Cronbach's Alpha=0.96) (manuscript one).

ii. Types of violence, revictimization, polyvictimization and cumulative violence

A series of questions on lifetime sexual and physical violence experiences during childhood (<18 years) and adulthood were asked. Violence items were adapted from the Revised Conflict Tactics Scale [41], a widely used scale designed for capturing IPV that has been used in previous sex work research, including our own work [42,43]. Childhood sexual violence (CSV) was defined as ever being pressured or forced sexual intercourse or sexual touching. Childhood physical violence (CPV) was defined as ever being hit, punched, slapped or otherwise physically hurt by someone causing marks or injury. Respondents who had experienced violence during childhood were also asked to select their relation to the perpetrator(s) from a list of options listed in **Table 10a**.

Adulthood exposures to violence were measured separately for four perpetrator types, which were found to be most common in the literature and in our previous work: intimate partners, sex work clients, police officers, and pimps/managers (if applicable). Adulthood sexual violence (ASV) was defined as physically forced sexual intercourse and adulthood physical violence by [perpetrator] (APV) was defined as being hit, punched, slapped or otherwise physically hurt by [perpetrator], or being threatened or hurt with a weapon by [perpetrator]. We also created four revictimization variables within each life stage and type of violence indicating if two or more perpetrator types were selected.

A binary variable ("any lifetime violence"; yes/no) was constructed using responses to CSV, CPV, ASV and APV. Individual trajectories of violence exposures that included permutations of responses to the four violence variables were constructed. Further, binary variables representing sexual and physical violence exposures by life stage were constructed (e.g. sexual violence during childhood only, sexual violence during adulthood only, sexual violence during childhood and adulthood; yes/no).

Sexual revictimization was defined in two ways: the first as exposure to sexual violence during childhood and adulthood (as depicted in **Figure 3**), and sexual violence perpetrated by ≥2 groups within each life stage (as described in **Tables 10a & 10b**). Physical revictimization was defined comparably. There are various definitions of polyvictimization in the literature, for example four or more types of traumatic and non-traumatic negative experiences during childhood[37] but given our focus on violent traumas, reporting both sexual and physical violence during either life stage was considered sufficient to constitute polyvictimization. This is related but distinct from the term "revictimization", which derived from research in the 1990's that focused on re-exposure

to sexual assault during childhood and adulthood. Cumulative violence was constructed using the sum of the number of lifetime violence types (i.e. from CSV, CPV, ASV, APV).

iii. Chronic strain

The survey included items on four types of chronic strain: homelessness in the past 3 months, financial insecurity in the past 3 months (defined as having no monthly savings), food insecurity in the past 3 months (defined as going to sleep at night hungry due to not having enough food) and having a criminal record for personal drug possession or engaging in sex work. The number of chronic strain items endorsed was used to construct a cumulative strain score.

iv. Drug use

Other survey measures were developed from previous work [31,42,43]. Frequency of substance use in the past 12 months was measured using pre-defined drug type categories, which included *daily* as the most frequent use option. Binary variables for daily opioid use (yes/no) and daily cocaine use (yes/no) were constructed. Opioids were defined as heroin use (injected/snorted/smoked) or misuse of "prescription pain killers such as Percocet, Morphine, OxyContin, Codeine, Fentanyl but not over the counter pills." Cocaine included use of smoking crack cocaine or snorting/injecting powder cocaine.

v. Binge drinking

The Alcohol Use Disorders Identification Test (AUDIT-C) is a validated brief (3-item) screening scale developed by the World Health Organization for assessing alcohol

disorders (scores range from 0-16).[44] A daily/almost daily binge drinking binary variable was constructed from the item "How often did you have four or more drinks on one occasion in the past year?" where daily/almost daily was a response option.

Data analysis

This analysis only included baseline data from FSW who were assigned as female at birth (i.e. cisgender women) recruited for the SAPPHIRE cohort, and who completed the PCL-5 scale (N=230). The dependent variable was PTSD severity, modeled as a continuous outcome. PTSD severity level (median scores) was compared for each of the covariates: violence type, cumulative violence, chronic strain, and substance use. Age-adjusted linear regressions with variance clustered for recruitment zone were used to model individual associations between PTSD severity and a range of covariates specified *a priori*: all four violence indicators, cumulative violence, chronic strain and substance use. Linear combinations of the cumulative violence variable were computed to test for statistically significant differences between each level.

Two multivariable linear regression models that were age-adjusted and accounted for variance clustering for recruitment zone examined two violence exposures. The "revictimization model", included all four types of violence as well as interaction terms for CSV by ASV, and CPV by APV and binge drinking. We tested several models adding all possible combinations of the three chronic strain variables (homelessness, financial insecurity and food insecurity; and the total number). The Akaike information criterion (AIC) was used to select the final model among the tested models. The "Cumulative Violence" model included the cumulative violence variable (modeled categorically); the

same procedure was used to arrive at the final model. Kernel Density plots were used to visualize the distribution of the studentized (jackknifed) residuals against a normal distribution and the Shapiro-Wilk's test was used to test for normality of the residuals from the final models but without variance clustering. All analyses were conducted in Stata/SE 14.2 (College Station, Texas).

Results

As shown in **Table 8**, mean age was 36 years (SD=9) and ranged from 18-61 years. The sample was mostly Non-Hispanic White (67%), followed by Non-Hispanic Black (23%) and Hispanic (4%) and Multiracial/Other (7%) and 65% engaged in sex work seven days a week in the past 3 months. Virtually all clients in the past 3 months were male (97%) (data not shown). Half of the sample (51%) did not complete high school; in the past 3 months, 62% were homeless, 89% had financial insecurity and 74% had food insecurity. The majority of the sample used opioids (74%) or stimulants (64%) daily, and 10% engaged in binge drinking on a daily or almost daily basis. PTSD was common; mean PTSD score was 39 (SD=22) and the median was 41 (interquartile range [IQR]=21-57).

Experiences of lifetime violence were common (82%). Thirty-five percent experienced CSV and 43% experienced CPV. The prevalence of ASV and APV were 40% and 72% respectively. **Figure 3** shows whether violence exposures occurred during childhood only, adulthood only or both time periods (i.e., the prevalence of life stage revictimization), by type of violence. **Figure 4** illustrates the median level of PTSD severity for each of these groups. The individual lifetime trajectories of all four types of violence are displayed in **Table 9**.

As shown in **Table 10a**, CSV was perpetrated predominantly by males, including a father/step-father (22%) or a male relative (34%); one in five (19%) who were exposed to CSV experienced polyvictimization during childhood. CPV was most commonly perpetrated by a father/step-father (50%), a mother/step-mother (27%), or an intimate partner (26%). Among the CPV group, 11% were polyvictimized during childhood.

Similarly, male clients (82%) and intimate partners (43%) perpetrated the majority of ASV followed by police (11%) (**Table 10b**). The prevalence of APV by clients and intimate partners were similarly high (66% and 69% respectively); police-perpetrated APV was also substantial (36%). Sexual and physical polyvictimization by multiple perpetrator groups were 33% and 54% respectively as an adult.

The relationship between violence (sexual, physical, revictimization and cumulative violence), chronic strain and substance use with PTSD severity is displayed in **Table 11**. CSV (β=14.43, 95% CI: 9.56, 19.31), ASV (β=14.04, 95% CI: 5.02, 23.06), CPV (β=12.35, 95% CI: 0.26-24.44) and APV (β=11.02, 95% CI: 1.74-20.29) were all associated with PTSD severity in separate age adjusted models. The association between PTSD severity and sexual (β=-1.36, 95% CI:-10.56-7.85) and physical (β=-5.35, 95% CI: -21.28-10.58) revictimization interaction terms were not statistically significant.

Cumulative violence was strongly associated with PTSD severity; compared to no reported lifetime violence, having 1 (β=6.02, 95% CI: 1.82, 10.21), 2 (β=16.96, 95% CI: 8.75, 25.16), 3 (β=18.32, 95% CI: 12.91, 23.73) or 4 (β=31.65, 95% CI: 24.48, 38.81) types of violence substantially increased PTSD severity; with significant PTSD differences between 2 vs. 1 (β=10.94, 95% CI: 3.68-18.21) and 4 vs. 3 types of violence (13.33, 95%

CI: 9.22-17.43) (median, IQR and range of PTSD severity, results of the differences between these levels of violence are displayed in **Figure 5**).

Low education (β=-8.77, 95% CI: -14.7, -2.85) and food insecurity (β=6.73, 95% CI: 0.85, 12.62) were two chronic strain factors associated with PTSD severity at the $p<0.05$ level. Homelessness (β=5.62, 95% CI: -0.53, 11.78) and financial insecurity (β=7.03, 95% CI: -0.77, 14.84) were marginally associated ($p<0.1$). Having a criminal record (β=-0.16, 95% CI: -3.77, 3.44) and cumulative strain (β=0.84, 95% CI:-0.80-2.48) were not significantly associated with PTSD severity. Daily opioid use (β=2.05, 95% CI: -7.24, 11.34) and daily stimulant use (β=0.82, 95% CI: -4.4, 6.04) were not significantly associated with PTSD severity while daily/almost daily binge drinking (β=10.8, 95% CI: -2.02, 23.62) was marginally ($p<0.1$) associated.

The revictimization multivariable model (**Table 11**) demonstrated strong associations between PTSD severity and CSV (β=11.33, 95% CI: 5.84, 16.82) and ASV, (β=11.08, 95% CI: 1.10, 21.06), marginal associations between PTSD severity and CPV (β=9.30, 95% CI: -0.51, 19.10) and APV (β=7.10, 95% CI: -1.71, 15.91), and no interaction effects for sexual (β=0.12, 95% CI: -9.73, 9.96) or physical revictimization (β=-7.94, 95% CI: -20.76, 4.87). Binge drinking was independently associated with increased PTSD severity (β=12.13, 95% CI: 3.18, 21.08). The Shapiro-Wilk's test accepted the null hypothesis of normality for the residuals from the revictimization model (p=0.14) and cumulative violence model (p=0.09).

A cumulative effect of the four types of violence assessed was observed in the second multivariable model (**Table 11**). Compared to FSW with no lifetime exposure to violence, FSW with one (β=6.83, 95% CI: 2.63, 11.02), two (β=17.98, 95% CI: 9.81,

26.16), three (β=18.81, 95% CI: 12.52, 25.1), or four (β=31.89, 95% CI: 22.00, 41.79) violence types exhibited significantly higher PTSD severity. Binge drinking remained associated with PTSD severity in this model (β=13.04, 95% CI: 3.98, 22.09).

Discussion

Street-based FSW are one of the most marginalized and vulnerable groups among FSW and in our society. This study, which was conducted in Baltimore city, documented strikingly high rates of family-, client-, police- and intimate partner-perpetrated sexual and physical violence. The mean PTSD score among these women was comparable to treatment-seeking war veterans.[45] Multivariate analyses revealed that both childhood and adulthood sexual violence were strongly associated with higher PTSD severity with marginal associations observed for physical violence. The association between revictimization and PTSD severity was not significant. Our second model demonstrated that cumulative violence had a dose-response relationship with PTSD severity. In both models, binge drinking was independently associated with higher PTSD severity whereas a chronic strain association was not observed. This study adds to the nascent literature on the relationships between accumulated violence, substance use and PTSD severity among a high-risk population of women.

Our first main finding was that when childhood and adulthood violence variables (sexual or physical) were modeled separately, each had a degree of association with PTSD severity. Given the degree of overlap in prevalence of sexual and physical violence indicators, many of these exposures likely occurred as separate incidents; an examination of the individual trajectories indicated that one in five FSW (49/220; 22%) experienced physical violence only and that physical violence was more common overall. Sexual

violence is often given more attention in the literature, and physical violence is often combined into a lifetime violence measure.[15,35,46] These findings demonstrate that future studies of PTSD severity should at minimum include separate sexual and physical violence measures asked for both childhood and adulthood.

Sexual and physical revictimization (i.e. violence in both childhood and adulthood) was high at 15% and 38% respectively. Among our sample, the prevalence of sexual and physical revictimization by multiple perpetrators was 19% and 26% during childhood, and 33% and 54% during adulthood, respectively. Notably, lifetime sexual revictimization nor physical revictimization had a significant association after adjusting for the independent associations of each violence indicator. While this may appear to contradict the findings in the revictimization literature, the revictimization measure used in this study notably differed from previous studies, which have defined revictimization as repeated events rather than exposure over the lifespan, and were not restricted solely to violent encounters.[35,36] This could signal the importance of each form of violence in the development of PTSD symptoms regardless of violence history. There could also be unmeasured confounding including PTSD attributable to revictimization or overall cumulative influence. This was explored in the second model.

We observed a non-linear dose-response relationship between cumulative violence and PTSD severity, which is consistent with previous findings that a dose-response relationship exists with greater frequency of abuse.[35] This was clearly indicated by the striking differences in median PTSD symptom severity between FSW who had experienced none or one of the types of violence measured (PCL-5 scores: 21 and 25) to women who were exposed to two, three or four categories of violence over the lifespan (PCL-5 scores:

43, 44 and 61), scores that met the PTSD cut-off of 33 indicating moderate to high PTSD symptoms.[47] This suggests that studies examining the associations between recent violence and PTSD should account for the accumulated impact of violence over the lifespan i.e. adopt a cumulative violence model.[35]

Sex work has been described as a high demand and low control occupation previously; these types of jobs are linked to chronic strain and poorer mental health outcomes.[48] Street-based sex work is particularly demanding and risky due to the aforementioned work environment (e.g. client violence), social and structural forces (e.g. sex work criminalization). While the "chronic strain" variables (homelessness, financial insecurity and food insecurity) were not independently associated with PTSD severity, their role requires further research given their prominence in the lives of FSW. Food insecurity held a bivariate with PTSD as observed previously (Hadley) and can be traumatic depending on severity (e.g. food deprivation is used as a control mechanism to traumatize sexual prisoners) and requires further investigation. Our participants were predominantly structurally vulnerable and so may have not had enough variability to model. Chronic strain may be a modifier or mediator of the relationships.

Almost all FSW in our study were daily substance users. In our study, FSW who engaged in frequent binge drinking exhibited higher PTSD severity. Compared to daily opioid or stimulant use, which were reported by the vast majority of FSW in our study, daily binge drinking was less prevalent, affecting one in ten FSW. Unlike other SUD, alcohol use disorders are characterized by memory impairment, which may be a factor explaining this finding;[49] future studies could examine whether self-suppression of intrusion symptoms is a factor contributing to binge drinking practices among FSW, as

observed among other female sexual assault survivors.[20] It is common clinical practice to treat a patient's substance use before PTSD among patients with co-morbidity.[23] While evidence shows that reductions in PTSD severity can be achieved with reductions in substance use frequency,[50,51] care must be taken when treating women who are actively using substances to cope with PTSD symptoms; drug withdrawal may trigger PTSD and drug relapse.[25] Concurrent treatment is recommended for these two conditions i.e. individual trauma-informed psychological interventions with SUD intervention.[23]

The health needs of street-based FSW are great, though resources targeting this population are often scarce, particularly in the U.S. context due to socio-political factors.[52] These findings demonstrate that violence, PTSD and substance use are prominent in the lives of street-based FSW. Despite being a multi-billion dollar industry, sex work is not recognized as a legal occupation in many countries including the U.S., except in Nevada. A negative consequence of criminalization laws in that FSW are often not afforded any legal protections, even when sexually or physically assaulted.[8] Decriminalizing sex work will likely improve FSW access to care, protection and justice.

There are limitations to consider when interpreting these findings. We observed relatively high residual PTSD in the "no violence" group. While we measured violence exposures from the most common perpetrators established in the literature, there are other groups that were missed, including neighbors and strangers. While unmeasured confounding due to other forms of trauma (e.g. witnessing violence, non-intentional violence) or risk factors (e.g. buffers) may have also confounded the associations with PTSD, assaultive violence results in the highest risk of PTSD in non-military populations.[3] Some dimensions of violence (e.g. severity, duration and the number of perpetrators within

each group of perpetrators) were also unmeasured. The data may be subject to social desirability bias. The cross-sectional nature of the study limits establishment of temporality of the relationships; longitudinal studies would certainly help to overcome this limitation and bolster the small body of literature on this topic.

This study is one of the first to examine the role of revictimization and cumulative violence in the etiology of PTSD among FSW, a population with exceedingly high levels of violence exposure throughout the life course. The levels of PTSD observed among FSW were high and comparable to that reported among treatment-seeking military veterans. Effective trauma-informed mental health interventions and violence prevention tools are urgently needed in this population. Chronic strain and substance use are major issues among this population that need to be addressed concurrently and local and national levels. Many gaps in the literature remain in our understanding of this complex phenomenon; this merits further research on the health of this uniquely vulnerable population.

Table 8: Violence, chronic strain, PTSD and substance use among street-based female sex workers in Baltimore, Maryland (N=230)

	n	%
Total	230	100.0
Demographics		
Age, mean (SD)	36 (9)	
Race/ethnicity		
Non-Hispanic White	154	67.0
Non-Hispanic Black	52	22.6
Hispanic	9	3.9
Multiracial/Other	15	6.5
Vulnerabilities		
Did not complete high school/GED	118	51.3
Length in sex work (> 5 years)	120	52.2
Current criminal record (sex work or drug conviction)	89	38.7
Violence		
Lifetime	194	80.8
Childhood sexual violence (CSV) [1]	77	34.4
Childhood physical violence (CPV) [2]	97	43.3
Adulthood sexual violence (ASV) [3]	91	39.6
Adulthood physical violence (APV) [4]	166	72.2
Chronic strain		
Homelessness, past 3 months	143	62.2
Financial Insecurity, past 3 months	205	89.1
Food Insecurity, past 3 months	171	74.4
Substance use		
Daily opioid and stimulant use	120	52.2
Daily opioid use only	50	21.7
Daily stimulant use only	27	11.7
Daily or almost daily binge drinking	22	9.6
Mental health		
PTSD severity, mean (SD)	39 (22)	
PTSD severity, median (IQR)	41 (21-57)	

Note: denominators vary due to data missingness

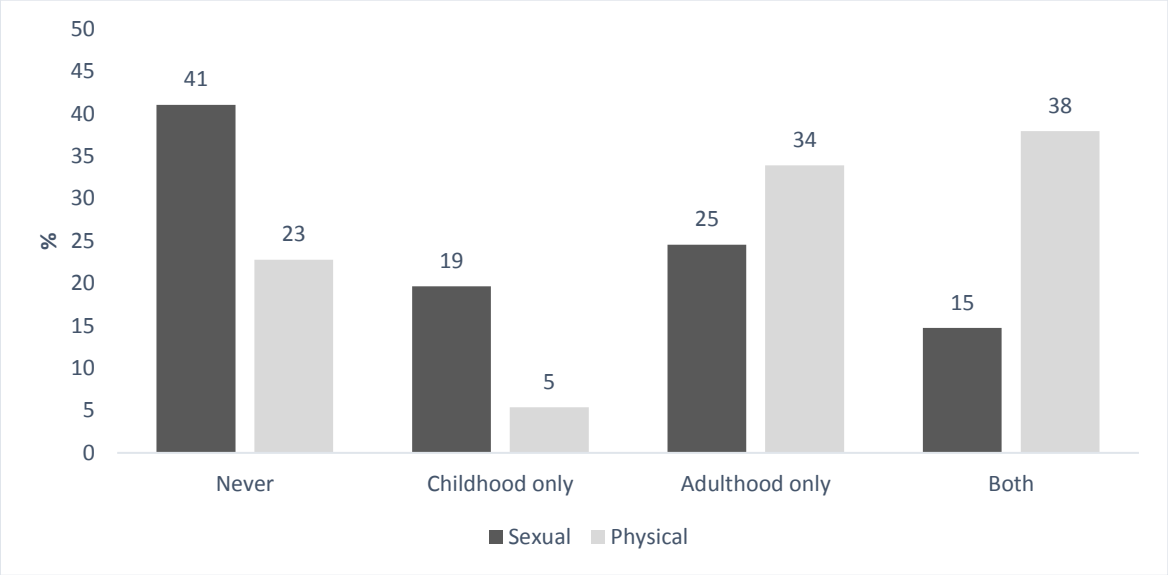
1. Pressured or forced to have sexual contact including sexual touching or sexual intercourse before age of 18.

2. Hit, punched, slapped or otherwise physically hurt before age of 18.

3. Forced to have sexual intercourse by clients, pimps/managers, intimate partners or police officers

4. Hit, punched, slapped or otherwise physically hurt or threatened with a weapon by clients, pimps/managers, intimate partners or police officers

Figure 3: Prevalence of sexual and physical violence and revictimization among street-based female sex workers in Baltimore, Maryland (N=220)



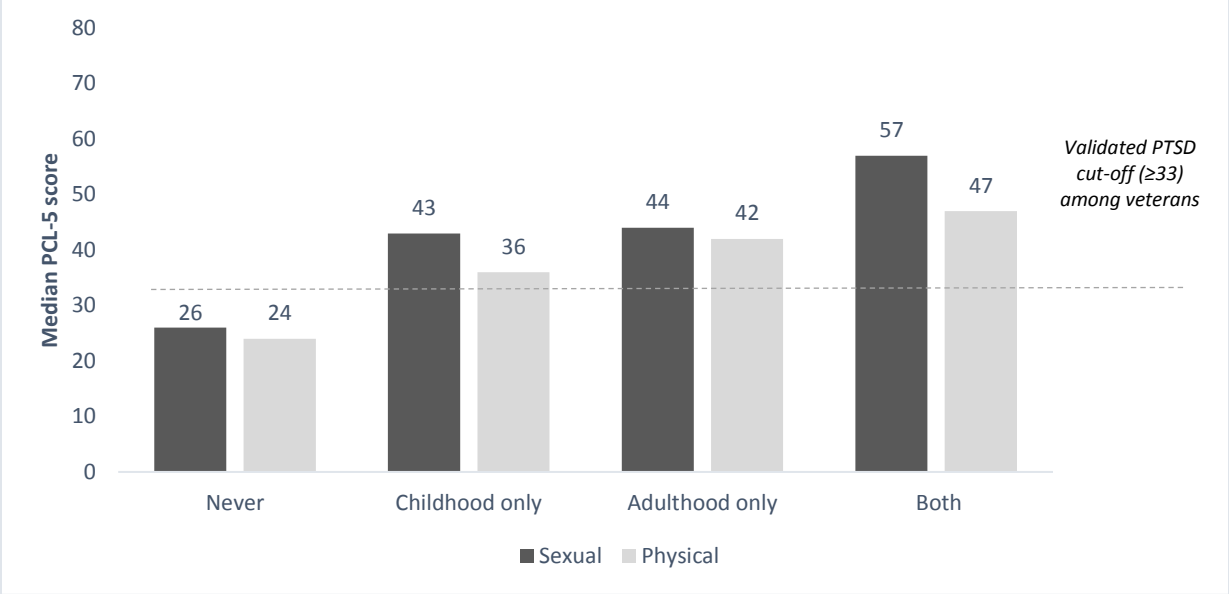
* Childhood defined as age<18 years. Revictimization indicated by "both" category.

Table 9: Sexual and physical violence experiences over the life course among street-based female sex workers in Baltimore, Maryland (N=220)

	Childhood		Adulthood		No. of types	n (column %)
	Sexual	Physical	Sexual	Physical		
No Sexual or Physical Violence (18.2%)					0	40 (18.2)
Childhood only (8.6%)	x				1	8 (3.6)
		x			1	7 (3.2)
	x	x			2	4 (1.8)
Adulthood only (28.6%)			x		1	2 (0.9)
				x	1	31 (14.1)
			x	x	2	30 (13.6)
Both (44.5%)	x		x		2	0 (0.0)
		x		x	2	11 (5.0)
	x			x	2	8 (3.6)
		x	x		2	0 (0.0)
	x	x	x		3	0 (0.0)
		x	x	x	3	22 (10.0)
	x		x	x	3	7 (3.2)
	x	x		x	3	24 (10.9)
	x	x	x	x	4	26 (11.8)

Light grey = Polyvictimization; Grey= Revictimization; Dark grey = Both

Figure 4: PTSD severity by exposure to sexual and physical violence among street-based female sex workers in Baltimore, Maryland (N=220)



* Childhood defined as age<18 years

Table 10a: Perpetrators of childhood sexual and physical violence among street-based female sex workers in Baltimore, Maryland (N=224)

	Childhood sexual violence*		Childhood physical violence**	
Variable	n	%	n	%
Overall prevalence of violence	77	34.4	97	43.3
Perpetrators (select all that apply)				
Father/step-father	17	22.1	47	49.5
Mother/step-mother	0	0.0	26	27.4
Sibling	4	5.2	8	8.4
Male relative	26	33.8	9	9.5
Female relative	2	2.6	7	7.4
Intimate partner	7	9.1	25	26.3
Client / "date"	1	1.3	2	2.1
Someone else	18	23.4	10	10.5
Don't know	8	10.4	0	0.0
Refused to answer	4	5.2	2	2.1
Revictimization^	14/73	19.2	25/95	26.3

**pressured or forced to have sexual contact including sexual touching or sexual intercourse before age of 18.*
***hit, punched, slapped or otherwise physically hurt before age of 18.*
^2 or more perpetrator types, excluding those who refused to answer

Table 10b: Perpetrators of adulthood sexual and physical violence among street-based female sex workers in Baltimore, Maryland (N=224)

	Adulthood sexual violence*		Adulthood physical violence**	
Variable	N	%	n	%
Overall prevalence of violence	91	39.6	166	72.2
Perpetrators (select all that apply)				
Intimate partner	39	42.9	113	69.3
Client	75	82.4	108	65.5
Police officer	10	11.0	59	35.5
Pimps/manager	1	1.1	2	1.2
Revictimization^	30/91	33.0	90/166	54.2

**forced to have sexual intercourse*

***hit, punched, slapped or otherwise physically hurt or threatened with a weapon*

 # Includes intimate partners, clients, pimps/managers, police; overall prevalence is likely an underestimate of adulthood violence experiences since the survey did not include other types of perpetrators
^2 or more perpetrator types, excluding those who refused to answer

Table 11: Violence, chronic strain, substance use and PTSD severity (PCL-5 score) among street-based female sex workers in Baltimore, Maryland (N=220)

	Median PTSD severity		Bivariate models[#]		Multivariable model (*Revictimization*)		Multivariable model (*Cumulative violence*)	
	Y	N	β (95% CI)	p	β (95% CI)	p	β (95% CI)	p
Violence								
Sexual violence - Childhood	48	32	14.43 (9.56, 19.31)	**<0.001**	11.33 (5.84, 16.82)	**0.001**		
Sexual violence - Adulthood	50	32	14.04 (5.02, 23.06)	**0.007**	11.08 (1.10, 21.06)	**0.033**		
Revictimization (Sexual x Sexual)			-1.36 (-10.56-7.85)	0.747	0.12 (-9.73, 9.96)	0.979		
Physical violence - Childhood	46	36	12.35 (0.26-24.44)	**0.046**	9.30 (-0.51, 19.10)	0.061		
Physical violence - Adulthood	44	27	11.02 (1.74-20.29)	**0.025**	7.10 (-1.71, 15.91)	0.102		
Revictimization (Physical x Physical)			-5.35 (-21.28-10.58)	0.467	-7.94 (-20.76, 4.87)	0.194		
Cumulative violence[%]								
0	21		REF				REF	
1	25		6.02 (1.82, 10.21)	**0.01**			6.83 (2.63, 11.02)	**0.005**
2	43		16.96 (8.75, 25.16)	**0.001**			17.98 (9.81, 26.16)	**0.001**
3	44		18.32 (12.91, 23.73)	**<0.001**			18.81 (12.52, 25.1)	**<0.001**
4	61		31.65 (24.48, 38.81)	**<0.001**			31.89 (22.00, 41.79)	**<0.001**
Chronic strain								
Homelessness, past 3 months	42	39	5.62 (-0.53, 11.78)	0.069				
Financial insecurity, past 3 months	42	38	7.03 (-0.77, 14.84)	0.072				
Food insecurity, past 3 months	42	34	6.73 (0.85, 12.62)	**0.029**				
Substance use								
No opioid or stimulant use	40		REF					
Daily opioid use only	39		2.14 (-13.12, 17.40)	0.759				
Daily stimulant use only	43		0.68 (-15.65, 17.01)	0.927				

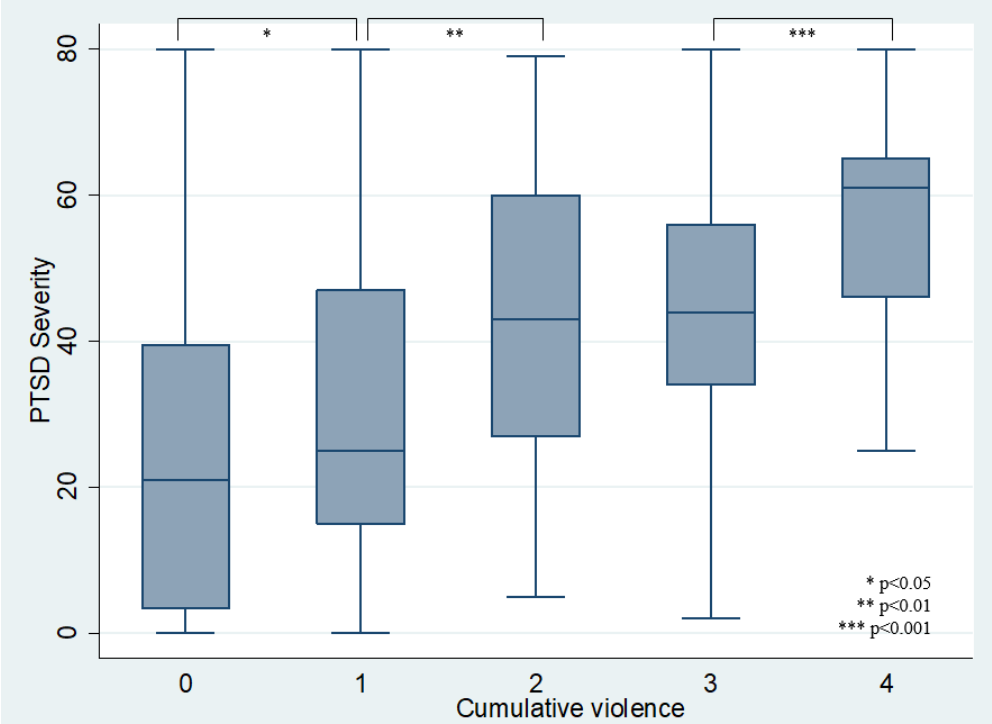
Daily opioid and stimulant use	43		2.44 (-10.92, 15.80)	0.689				
Daily or almost daily binge drinking	53	40	10.8 (-2.02, 23.62)	0.089	12.13 (3.18, 21.08)	**0.013**	13.04 (3.98, 22.09)	**0.01**

**Linear regression with robust variance adjusted for age. Revictimization model includes two interaction terms (sexual and physical revictimization).*

^ Sex work or drug conviction

 # Age-adjusted % no. of types of violence exposures

Figure 5: Distribution of PTSD severity by levels of cumulative violence among street-based female sex workers in Baltimore, Maryland (N=220)



End of whiskers represent the adjacent values i.e. upper limit=Q3 + 1.5 × IQR.

Linear combinations of bivariate cumulative violence linear regression model used for significance testing between levels of violence.

References

1. World Health Organization. *Global and regional estimates of violence against women: prevalence and health effects of intimate partner violence and non-partner sexual violence.* World Health Organization; 2013.
2. Black MC, Basile KC, Breiding MJ, et al. The national intimate partner and sexual violence survey (NISVS): 2010 summary report. *Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.* 2011;25.
3. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of general psychiatry.* 1998;55(7):626-632.
4. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of general psychiatry.* 1995;52(12):1048-1060.
5. Olff M, Langeland W, Draijer N, Gersons BP. Gender differences in posttraumatic stress disorder. *Psychological bulletin.* 2007;133(2):183.
6. Ullman SE, Filipas HH, Townsend SM, Starzynski LL. Psychosocial correlates of PTSD symptom severity in sexual assault survivors. *Journal of traumatic stress.* 2007;20(5):821-831.
7. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol.* 2000;68(5):748-766.
8. Decker MR, Crago AL, Chu SK, et al. Human rights violations against sex workers: burden and effect on HIV. *Lancet.* 2015;385(9963):186-199.
9. Deering KN, Amin A, Shoveller J, et al. A systematic review of the correlates of violence against sex workers. *Am J Public Health.* 2014;104(5):e42-54.
10. Shannon K, Strathdee SA, Goldenberg SM, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet.* 2015;385(9962):55-71.
11. Shannon K, Kerr T, Strathdee SA, Shoveller J, Montaner JS, Tyndall MW. Prevalence and structural correlates of gender based violence among a prospective cohort of female sex workers. *BMJ.* 2009;339:b2939.
12. Lim S, Peitzmeier S, Cange C, et al. Violence against female sex workers in Cameroon: accounts of violence, harm reduction, and potential solutions. *JAIDS Journal of Acquired Immune Deficiency Syndromes.* 2015;68:S241-S247.
13. Wirtz AL, Schwartz S, Ketende S, 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-S179.
14. Surratt HL, Kurtz SP, Chen M, Mooss A. HIV risk among female sex workers in Miami: the impact of violent victimization and untreated mental illness. *AIDS Care.* 2012;24(5):553-561.
15. Surratt HL, Kurtz SP, Weaver JC, Inciardi JA. The Connections of Mental Health Problems, Violent Life Experiences, and the Social Milieu of the "Stroll" with the HIV Risk Behaviors of Female Street Sex Workers. *Journal of Psychology & Human Sexuality.* 2005;17(1-2):23-44.
16. Farley M, Cotton A, Lynne J, et al. Prostitution and trafficking in nine countries: An update on violence and posttraumatic stress disorder. *Journal of Trauma Practice.* 2004;2(3-4):33-74.
17. Roxburgh A, Degenhardt L, Copeland J. Posttraumatic stress disorder among female street-based sex workers in the greater Sydney area, Australia. *BMC Psychiatry.* 2006;6:24.

18. Bovin MJ, Marx BP, Weathers FW, et al. Psychometric properties of the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5) in veterans. *Psychol Assess.* 2016;28(11):1379-1391.
19. Vanwesenbeeck I. Another decade of social scientific work on sex work: a review of research 1990-2000. *Annu Rev Sex Res.* 2001;12:242-289.
20. Ullman SE, Relyea M, Peter-Hagene L, Vasquez AL. Trauma histories, substance use coping, PTSD, and problem substance use among sexual assault victims. *Addictive behaviors.* 2013;38(6):2219-2223.
21. Kilpatrick DG, Acierno R, Resnick HS, Saunders BE, Best CL. A 2-year longitudinal analysis of the relationships between violent assault and substance use in women. *Journal of consulting and clinical psychology.* 1997;65(5):834.
22. Krause ED, Kaltman S, Goodman LA, Dutton MA. Avoidant coping and PTSD symptoms related to domestic violence exposure: A longitudinal study. *Journal of Traumatic Stress.* 2008;21(1):83-90.
23. Roberts NP, Roberts PA, Jones N, Bisson JI. Psychological interventions for post-traumatic stress disorder and comorbid substance use disorder: A systematic review and meta-analysis. *Clinical psychology review.* 2015;38:25-38.
24. Weaver TL, Gilbert L, El-Bassel N, Resnick HS, Noursi S. Identifying and intervening with substance-using women exposed to intimate partner violence: phenomenology, comorbidities, and integrated approaches within primary care and other agency settings. *Journal of women's health.* 2015;24(1):51-56.
25. Jacobsen LK, Southwick SM, Kosten TR. Substance use disorders in patients with posttraumatic stress disorder: a review of the literature. *American Journal of Psychiatry.* 2001;158(8):1184-1190.
26. Heise LL, Kotsadam A. Cross-national and multilevel correlates of partner violence: an analysis of data from population-based surveys. *The Lancet Global Health.* 2015;3(6):e332-e340.
27. Heise L. What works to prevent partner violence? An evidence overview. 2011.
28. Connell RW. *Gender and power: Society, the person and sexual politics*. Stanford University Press; 1987.
29. Erausquin JT, Reed E, Blankenship KM. Police-related experiences and HIV risk among female sex workers in Andhra Pradesh, India. *J Infect Dis.* 2011;204 Suppl 5:S1223-1228.
30. Rhodes T, Simic M, Baros S, Platt L, Zikic B. Police violence and sexual risk among female and transvestite sex workers in Serbia: qualitative study. *BMJ.* 2008;337:a811.
31. Brantley ML, Footer KHA, Lim S, Kerrigan D, Sherman SG. Experiences of structural vulnerability among exotic dancers in Baltimore, Maryland: Co-occurring social and economic antecedents of HIV/STI risk. *Int J Drug Policy.* 2017;50:74-81.
32. Rhodes T, Wagner K, Strathdee SA, Shannon K, Davidson P, Bourgois P. Structural violence and structural vulnerability within the risk environment: theoretical and methodological perspectives for a social epidemiology of HIV risk among injection drug users and sex workers. In: *Rethinking social epidemiology.* Springer; 2012:205-230.
33. Maher L, Curtis R. Women on the edge of crime: Crack cocaine and the changing contexts of street-level sex work in New York City. *Crime, law and social change.* 1992;18(3):221-258.
34. Breslau N. Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. In: SAGE Publications Sage CA: Los Angeles, CA; 2002.
35. Scott-Storey K. Cumulative abuse: do things add up? An evaluation of the conceptualization, operationalization, and methodological approaches in the study of the phenomenon of cumulative abuse. *Trauma, Violence, & Abuse.* 2011;12(3):135-150.
36. Walsh K, Danielson CK, McCauley JL, Saunders BE, Kilpatrick DG, Resnick HS. National prevalence of posttraumatic stress disorder among sexually revictimized

adolescent, college, and adult household-residing women. *Arch Gen Psychiatry.* 2012;69(9):935-942.
37. Finkelhor D, Ormrod RK, Turner HA. Polyvictimization and trauma in a national longitudinal cohort. *Development and psychopathology.* 2007;19(1):149-166.
38. Thoits PA. Stress and health: Major findings and policy implications. *Journal of health and social behavior.* 2010;51(1_suppl):S41-S53.
39. Turner RJ, Wheaton B, Lloyd DA. The epidemiology of social stress. *American sociological review.* 1995:104-125.
40. Weathers FW, Litz BT, Keane TM, Palmieri PA, Marx BP, Schnurr PP. The PTSD Checklist for DSM-5 (PCL-5). . 2013.
41. Straus MA, Hamby SL, Boney-McCoy S, Sugarman DB. The revised conflict tactics scales (CTS2) development and preliminary psychometric data. *Journal of family issues.* 1996;17(3):283-316.
42. 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 Behav.* 2017;21(10):3047-3056.
43. Decker MR, Nail JE, Lim S, Footer K, Davis W, Sherman SG. Client and Partner Violence Among Urban Female Exotic Dancers and Intentions for Seeking Support and Justice. *J Urban Health.* 2017;94(5):637-647.
44. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. *Archives of internal medicine.* 1998;158(16):1789-1795.
45. Wortmann JH, Jordan AH, Weathers FW, et al. Psychometric analysis of the PTSD Checklist-5 (PCL-5) among treatment-seeking military service members. *Psychol Assess.* 2016;28(11):1392-1403.
46. Ulibarri MD, Semple SJ, Rao S, et al. History of abuse and psychological distress symptoms among female sex workers in two Mexico-U.S. border cities. *Violence Vict.* 2009;24(3):399-413.
47. Hoge CW, Riviere LA, Wilk JE, Herrell RK, Weathers FW. The prevalence of post-traumatic stress disorder (PTSD) in US combat soldiers: a head-to-head comparison of DSM-5 versus DSM-IV-TR symptom criteria with the PTSD checklist. *Lancet Psychiatry.* 2014;1(4):269-277.
48. Wingood GM, DiClemente RJ. Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. *Health education & behavior.* 2000;27(5):539-565.
49. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub; 2013.
50. Hien DA, Jiang H, Campbell AN, et al. Do treatment improvements in PTSD severity affect substance use outcomes? A secondary analysis from a randomized clinical trial in NIDA's Clinical Trials Network. *American Journal of Psychiatry.* 2009;167(1):95-101.
51. Manhapra A, Stefanovics E, Rosenheck R. Treatment outcomes for veterans with PTSD and substance use: Impact of specific substances and achievement of abstinence. *Drug & Alcohol Dependence.* 2015;156:70-77.
52. Decker MR, Beyrer C, Sherman SG. Ending the invisibility of sex workers in the US HIV/AIDS surveillance and prevention strategy. *AIDS.* 2014;28(15):2325-2327.

CHAPTER FOUR: MANUSCRIPT THREE

The temporal relationship between violence and PTSD severity: Results from a longitudinal cohort study of female sex workers

Abstract

Street-based female sex workers (FSW) are a population characterized by social marginalization, and vulnerability to sexual and physical violence, drug use and PTSD. This study examined the impact of violence and drug use on PTSD severity over six months of follow-up among this population.

Between 2016 and 2017, street-based cisgender FSW (N=250) were enrolled into the SAPPHIRE (Sex workers And Police Promoting Health In Risky Environments) study, an observational prospective cohort study. Participants completed the PTSD Checklist (PCL-5) at baseline and six-month follow-up as part of a socio-behavioral health survey. Multinomial regression was used to model change in PTSD severity over time. High PTSD severity was operationalized as having a PCL-5 score ≥ 33.

Among FSW with data at both visits (N=130), the most common PTSD symptom pattern that emerged between baseline and 6-month follow-up was high stable PTSD severity (47%), followed by low stable PTSD severity (23%), and PTSD severity that changed from high-to-low (16%) and low-to-high (14%). Multinomial regression analysis revealed that higher exposure to cumulative violence at baseline predicted high PTSD severity at baseline only (RR=1.67, 95% confidence interval [CI]: 1.01-2.74) and at both time points (RR=2.51, 95% CI: 1.61-3.90). Having high stable PTSD severity after six months regardless of baseline PTSD level appeared to be driven by recent polyvictimization though these associations did not reach statistical significance. The

interaction term testing changes in drug use (baseline to 6 month follow-up) as an effect modifier was not significant.

Findings highlight that street-based FSW have a complex and chronic set of safety and mental health needs. Our study was likely limited by the modest sample size and relatively short follow-up period. Nevertheless, the current results could inform the development of trauma-informed services tailored for street-based FSW in urban settings.

Introduction

The majority of people will experience at least one traumatic event in their lifetime; urban communities face exceptionally high burden of trauma.[1] Traumatic events may be directly experienced, witnessed, or affect a close friend or family member; examples include accidents, natural disasters and assaultive violence (i.e., sexual or physical violence).[2] Adolescents and younger adults are at higher risk of traumatic event exposure compared to other age groups, and women are more likely to be sexually victimized than men.[1] While posttraumatic stress disorder (PTSD) is one of the most common mental health consequences of trauma, the majority of trauma survivors do not develop chronic PTSD.[3,4] Type of trauma appears to influence PTSD risk; survivors of sexual and physical violence are at highest risk of developing PTSD compared to survivors of other forms of trauma.[1] Women are at higher risk of developing PTSD than men and having persistent symptoms regardless of trauma type.[5] Trauma type has been shown to influence health behaviors; for example, one study showed that exposure to assaultive violence is associated a higher rate of substance use coping compared to other traumatic exposures.[6]

Outside of military populations, few longitudinal studies have examined the course of PTSD symptoms following assaultive violence. A systematic review published in 2013 identified 35 longitudinal studies on this phenomenon among men and women between 1998 and 2010; only four of them specifically studied assaultive violence as the exposure[4] though some research has emerged since.[6-8] The review nevertheless elucidated a key finding: that the 12-month course of PTSD symptom severity appears dependent on whether the trauma was "intentional" (i.e. stemming from assaultive violence or war-related trauma) or "non-intentional" (i.e. natural disasters, motor vehicle accidents).[4] On

average, PTSD severity appears to persist or worsen over the course of one year among survivors of intentional traumas, whereas substantial improvements in PTSD symptoms are observed among non-intentional trauma survivors.[4] For both types of trauma, PTSD severity has been observed to be highest within the first year of exposure to trauma,[9,10] with symptoms most often beginning two to four weeks of traumatic events, indicating the importance of examining the temporal proximity between traumatic exposures and PTSD.[11] Polyvictimization, defined as exposure to multiple types of trauma, and cumulative violence, defined as the lifetime number of trauma types, have been shown to be associated with increased risk of PTSD and substance use among women in one study.[12,13] Given these findings, there is remains a pressing need for research on the factors that moderate associations between trauma and mental health outcomes.

Violence against female sex workers (FSW) is a chronic and pervasive issue worldwide; between 40-60% of FSW experience violence in their lifetime.[14] Street-based female sex workers (FSW) are a highly marginalized population characterized by high rates of sexual and physical violence victimization, as well as co-morbid substance use and structural vulnerability.[15-17] Men are the most common perpetrators of violence against FSW from childhood through to adulthood; to date, the FSW literature has focused on clients who solicit sex, police officers and intimate partners. [14,18] Some scholars hypothesize that the detrimental effects of violence on mental health accumulate over the life course. FSW also face multiple barriers to accessing health care, partially owing to criminalization and stigmatization surrounding sex work though the literature in the U.S. context is sparse.[19,20] Unsurprisingly, the prevalence of PTSD symptoms among FSW is high with published estimates of 47% or greater though temporal relationships have not

been explored.[21,22] Substance use plays a central role in the lives of many FSW, and particularly among women engaged in street-based sex work. While further investigation of the factors explaining the high comorbidity between substance use and violence among street-based FSW is warranted, it is established that early drug dependence plays a critical role in the decision to enter street-based sex work.[15] Childhood abuse and early adversities has also been linked with drug use and sex work initiation.[23-25] Drugs may also be used as an avoidant coping mechanism to dissociate/numb the detrimental effects of trauma and emotional difficulties associated with sex work.[6,26] Co-morbid substance use and PTSD is of concern clinically as it has been shown to lead to worse prognosis and more complex treatment procedures.[27,28]

This study aims to contribute to the nascent literature on the impact of accumulating violence on PTSD symptoms over time among FSW. We first examined the influence of recent exposure to polyvictimization (sexual and physical violence from clients, police and intimate partners) on changes in PTSD severity in the presence of lifetime cumulative violence measured at baseline. We then tested the moderating effect of substance use in the relationship between polyvictimization and PTSD severity. Data were drawn from an observational urban cohort of street-based FSW.

Methods

Sample

From 2016 to 2017, the Sex workers And Police Promoting Health In Risky Environments (SAPPHIRE) study recruited FSW of ages 15 years or older from selected street-based locations in Baltimore, Maryland into an observational prospective cohort

study. The methods of the study are described in detail elsewhere (manuscripts under review). The SAPPHIRE cohort was the third phase of a multi-phase mixed-methods study examining the role of police on the HIV/STI risk environment of FSW. The cohort study consisted of a baseline visit and four follow-up visits over the course of one year. Participants completed an interviewer-administered survey and completed HIV/STI testing at each visit. At the end of the visit, the interviewer offered referrals to local health and social service organizations as appropriate, including violence shelters. Participants were compensated with a pre-paid $70 VISA card for completing the baseline and 12-month visit, and $45 VISA cards for completing the 3-, 6- and 12-month follow-up visits. Participants who missed one or two follow-ups were still eligible to complete their remaining follow-up visits. The study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

i. Socio-demographic, sex work and drug use characteristics

The baseline survey included items on age, race/ethnicity, education, homelessness, legal employment status, age at sex work entry, sex trafficking history, frequency of sex work and reasons for current engagement in sex work.

The survey also captured data on the frequency of drug use based on our previous studies. Binary variables for recent (past 3 month) opioid use (yes/no) and cocaine use (yes/no) were constructed. Opioids were defined as heroin use (injected/snorted/smoked) or misuse of "prescription pain killers such as Percocet, Morphine, OxyContin, Codeine, Fentanyl but not over the counter pills." Cocaine use included use of smoking crack

cocaine or snorting/injecting powder cocaine. A global binary recent opioid/cocaine use variable was constructed due to the high degree of overlap in their use in this sample.

ii. PTSD severity (PCL-5)

The presence of self-reported PTSD symptoms were measured at baseline and 6-month follow-up using the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5)[29], a 20-item scale consisting of past month PTSD symptoms and ranging from 0 to 80. Responses for each symptom were recorded using a 5-point Likert scale (0=not at all, 1=a little bit, 2=moderately, 3=quite a bit, 4=extremely). PTSD symptom severity was calculated using the participant's overall score on the PCL-5 scores. Internal consistency of the PCL-5 at both time points was high (Cronbach's α=0.96 & 0.97).

While validation studies among veterans use a cut-off of 33 to indicate clinically significant symptom levels, after considering both clinical relevance and the distribution of the data, PTSD severity was categorized into two levels (low versus high) using the sample mean as the cut point for statistical analysis; low was defined as PCL-5<40 and high was defined as PCL-5≥40. For example, a patient responding moderately/quite a bit/extremely to all items would score of 40 or higher and be categorized as exhibiting "high PTSD severity".

The first 20 participants did not complete the PCL-5 at baseline since the scale was included after the study was launched. A small number of respondents (n=5) had missing responses to one item; these missing responses were coded as zero to retain them in the analysis as a conservative approach. This did not impact their categorization in the outcome variable i.e. PTSD group.

iii. Cumulative violence

Violence items were adapted from the Revised Conflict Tactics Scale [30] as described previously (manuscript 2). At baseline, we measured several types of violence; childhood sexual abuse and childhood physical abuse, and client, police and intimate partner violence by type (sexual and physical) and timeframe (ever and past 3 months). At each follow-up visit, we measured past 3 month exposure to violence for each perpetrator group (clients, police and intimate partners). Specifically, sexual violence was defined as being physically made/forced have sexual intercourse. The definition of childhood (<18 years) sexual violence in this study also included being pressured into sexual intercourse and unwanted sexual touching. Physical violence was measured through two items on being physically hurt (e.g. hit, punched, slapped) or being threatened or exposed to a weapon (e.g. gun or knife) by a perpetrator. Childhood physical violence was defined as ever being hit, punched, slapped or otherwise physically hurt by someone causing marks or injury.

There is no consistency in the literature in measuring cumulative violence. Baseline cumulative violence incorporated data from four violence types as previously defined (manuscript 2); childhood sexual violence, childhood physical violence, adulthood sexual violence and adulthood physical violence. These variables we summed to calculate the baseline cumulative violence score (range: 0 to 4). The recent violence variables were constructed by collapsing violence type- and perpetrator-specific responses from 3 month and 6 month follow-up into binary variables. These variables were then collapsed into a three-level global cumulative violence variable (0=no recent violence; 1=recent violence: one type; 2=recent violence: multiple types).

Statistical analysis

Data were restricted to those who completed baseline, 3 month and 6 month follow-up, had a PCL-5 score at baseline and 6 month, and had no missingness in the outcomes (N=137). The sample size at each analytic restriction step are described in **Table 12**. The overall 6 month retention rate for the SAPPHIRE cohort was 74%, excluding those who were unable to participate due to prohibitive reasons; among those women, the most common reasons were being incarcerated (19%), deceased (8%), moving out of Baltimore (8%), drug rehabilitation (6%), or refusal to participate (3%). These reasons were ascertained either from the participant at a later date or from their contacts/peers.

Table 12: SAPPHIRE cohort retention and analytic restrictions

Step	Sample size
Enrolled	N=250
Has PCL-5 score at baseline	N=230
Completed 3-month	N=166
Completed 6-month	N=137
Has PCL-5 score at 6-month	N=137
Complete case analysis (multivariable analysis)	N=130

Exploratory data analysis

We first described the baseline prevalence of key characteristics i.e. demographic, childhood, sex work, housing, drug use and violence history. We also calculated the cumulative incidence of recent sexual and physical violence experiences that occurred during follow-up, by perpetrator type, as well as describing the overall ("any"), and number

of types of violence ("polyvictimization"). A tetrachoric correlation matrix was used to assess the level of correlation between the recent violence indicators.

The raw dependent variable (PTSD symptom severity) was visually explored using a variety of methods. Box-and-whisker plots of PTSD scores measured at baseline and 6-month follow-up; histogram of the PTSD score changes; line graphs of changes in median PTSD among the four PTSD levels. The non-parametric relationships between baseline PTSD severity and the continuous covariates baseline cumulative violence and age were visually explored using lowess plots (data not shown).

The temporal patterns in changes housing and drug use in past 3 months between baseline and 6 month follow-up were explored by constructing four-level categorical variables; homelessness was conceptualized as either sustained, new, no longer homeless, or none. Drug use (that only included opioid/cocaine use) was described as sustained, initiation, cessation or no use. These four types of patterns were plotted against median PTSD severity.

In order to explore the differences between FSW who were lost to follow-up at each follow-up to those who were retained among the 230 participants who had a PCL-5 score at baseline, we compared these groups on key demographic, substance use, violence and PTSD covariates and tested differences using the Student's t-test for continuous variables and Pearson's chi-square test for categorical variables (**Supplementary Tables S1 and S2**).

Multivariable models

The multivariate associations between violence, drug use and six-month changes in PTSD level was examined using three multinomial regression models and complete case analysis (N=130). The PTSD outcome in all three models was a constructed variable that categorized women into two PTSD symptom groups at baseline and 6-month i.e. "low" (PCL-5<33) or "high" (PCL-5≥33), resulting in a four-level variable over the two time points (PTSD severity is low stable/high to low/low to high/high stable). The "low stable" group was used as the reference group in all three models and p-values < 0.05 indicated statistical significance.

The three models differed on covariates included. The "Baseline Model" examined the association between lifetime violence history at baseline (baseline cumulative violence) adjusted for age. The "Baseline + Recent Violence Model" added the three-level recent violence variable (no recent/one/multiple types). The "Baseline + Recent Violence +Drug Use Interaction Model" added an interaction term between recent violence and the reduced drug use variable. In this final model, the recent violence variable had to be simplified into a binary variable (no/yes) due to model convergence issues.

Wald tests were used to compare between levels of the PTSD outcome (e.g. "High to low" vs. "Low to high"). The Akaike information criterion (AIC) model fit statistic are reported for each model.

In order to assess whether recent violence influenced linear change in PTSD over time, we treated PTSD as a continuous variable and modeled 6-month PTSD with baseline PTSD, cumulative violence, age and recent violence as covariates in a linear regression model.

Results

Among the sample (N=137), mean age was 37 years (standard deviation [SD]=9), the majority were non-Hispanic White (71%), followed by non-Hispanic Black (19%) and Hispanic/multiracial/other (10%); 52% did not complete high school and 91% were legally unemployed (**Table 13**). Some (18%) were aged less than 18 when they initiated sex work, and a small minority (6%) were trafficked into sex work. Virtually all clients in the past 3 months were male (97%) (data not shown). Most (65%) engaged in sex work daily in the past 3 months and were homeless (62%), and almost all (96%) used heroin or cocaine at baseline. One in five (20%) reduced their drug frequency between baseline and their 6-month visit. Violence history among the sample at baseline was extensive; 36% and 46% were exposed to childhood sexual and physical violence respectively, and sexual and physical violence estimates perpetrated by clients, police officers or intimate partners ranged from 4%-51%. The women were exposed to a median of two violence types in their lifetime.

Median PTSD severity remained high between baseline and 6-month follow-up (PCL-5 score 43 vs. 41) (**Figure 6**). The distribution of individual-level 6-month changes in PTSD score are displayed in **Figure 7**. Median change in PTSD levels stratified by PTSD group are plotted in **Figure 8**. Overall, 47% were classified as "High Stable", 16% as "High to Low", 14% as "Low to High" and 23% as "Low Stable" after comparing PTSD at baseline and 6 month follow-up.

Cumulative incidence estimates of recent exposure to violence are located in **Table 14**. Recent (past 6 month) client violence was the most common type followed by intimate partner violence. Overall cumulative incidence of violence over 6 months of follow-up

was 43%; of these 59 women, the majority (68%) were polyvictimized i.e. experienced both sexual and physical violence, and/or violence from multiple perpetrator groups. The tetrachoric correlations between the recent violence indicators are displayed in **Table 15**.

The results of the multivariate multinomial regression analyses are displayed in **Table 16**. Compared to women in the "Low Stable" PTSD group, the risk of being in the "High to Low" group (RR=1.67, 95% confidence interval [CI]: 1.01-2.74) or "High Stable" group (RR=2.51, 95% CI: 1.61-3.90) was significantly higher among women with a higher level of baseline cumulative violence. In contrast, there was no difference between "Low to High" and "Low Stable" groups by baseline cumulative violence (RR=1.54, 95% CI: 0.91-2.61). A higher risk of being "High Stable" compared to "Low to High" was also observed to be associated with higher baseline cumulative violence (Wald test; p=0.04).

After accounting for recent violence, which was non-significant in across all three models, the risk of being in the "High Stable" group compared to the "Low Stable" group was higher among women with higher baseline cumulative violence (RR=2.19, 95% CI: 1.38-3.48) (**Table 16**). Additionally, the risk of being "High Stable" compared to being "Low to High" was higher among women with higher baseline cumulative violence (Wald test; p=0.04). No evidence of modification by drug use frequency was observed. The "Baseline Model" had the lowest AIC statistic, indicating better fit than the second and third models of increasingly complexity.

We also explored whether modeling PTSD as a continuous outcome affected the results. Results were consistent with the multinomial regression models. In this linear regression model, baseline cumulative violence was strongly associated with PTSD severity at 6-month follow-up (p<0.019) and the recent violence association was not

significant (p=0.698). The recent violence by drug use interaction term was also non-significant (p=0.934) (results not shown).

Discussion

This study examined the relationship between accumulated exposure to interpersonal violence and temporal changes in PTSD symptoms over six months among street-based FSW, a largely polyvictimized population. While overall PTSD levels of the full sample remained virtually unchanged after six months of observation, four distinct PTSD groups emerged when we accounted for within-individual change; the most common group were FSW who had high stable PTSD severity, followed by low stable, low-to-high and high-to-low PTSD. In our cohort, changes in PTSD over a six month period was driven primarily by cumulative violence (i.e. lifetime) exposures reported at study enrollment, which is consistent with the few existing studies that comprehensively measure PTSD change and violence across the life span among a population of non-military women. To our knowledge, this is the first study to examine the relationship between temporal changes in PTSD severity and cumulative violence among a longitudinal cohort of FSW.

In this high-trauma sample of FSW, we observed that cumulative violence at time of study enrollment predicted changes in PTSD over a six-month period. Higher baseline cumulative violence placed women at higher risk of having high PTSD severity at baseline, most of whom had persistently high PTSD at follow-up. Given that the vast majority of the women had a history of trauma, including high rates of childhood abuse, and the relatively short follow-up period of six months, the significance of baseline cumulative violence on changes in PTSD were predictable. The dangers associated with street-based sex work in an urban setting are well-established with clients and police being contributors

of risk.[14,16,31] The high exposure to workplace violence at baseline and follow-up is likely in part explained by their length of engagement in sex work; the majority of our sample had been in street-based sex work for more than five years. This study occurred in Baltimore city, where violence is an endemic public health issue; crime has been rampant in recent years with over 9,500 violent crimes recorded in 2016, of which 318 were homicides.[32]

Having high PTSD severity after six months of follow-up regardless of baseline PTSD levels appeared to be driven by recent polyvictimization as shown by the large relative risk ratios, though these associations did not reach statistical significance. The relative risk ratios for FSW recently exposed to one type of violence however were close to the null; no association with changes in PTSD were detected. Only five FSW exposed recently to violence were "new" victims whereas over 90% of the recent violence cases had a history of violence exposure at baseline. Our findings indicate the critical importance of measuring cumulative violence in this highly vulnerable poly-trauma population when studying their mental health and in the clinical setting. Clinicians and researchers should also note that attributing their PTSD to a single self-reported "worst event" at one time point may not be a valid representation of their complex trauma histories characterized by revictimization and polyvictimization (manuscript two).

Changes in drug use frequency did not appear to moderate the observed associations, although studies with larger sample size and longer follow-up periods are likely needed in order to elucidate the complex relationship between cumulative exposures to violence and drug use. Whether drug use moderates the impact of recent exposure to violence and changes in PTSD will require further investigation; our study did not see a

statistically significant association. Drug use histories are complex among street-based FSW, with the majority in Baltimore being polysubstance users who inject drugs (manuscripts under review). Among urban community-based samples of women, cumulative trauma and sexual assault severity was associated with higher reliance on substance use to cope with the trauma of sexual assault.[6] Studies with larger sample size and longer follow-up periods are likely needed in order to elucidate the complex relationship between cumulative exposures to violence and drug use among FSW.

This research is subject to limitations. Due to loss to follow-up, our analytic sample size was modest, which may have driven the lack of significance of the recent violence associations. We used complete case analysis in this study as we did not see significant baseline differences in PTSD levels among retained and non-retained FSW, however, future studies could handle data missingness with additional statistical methods such as multiple imputation or inverse probability weighting. The results may have been influenced by cutpoint bias i.e. by categorizing the continuous PCL-5 score into "high" vs. "low" PTSD symptoms using the cut-off validated among veterans (PCL-5≥33), the outcome used in multivariable modelling artificially masked variability within the data. Given that many FSW who were categorized as having "low" PTSD symptoms had subthreshold PTSD symptoms, choosing a different cut-off may have changed the estimates. It is also plausible that there are more than two (i.e. "high" vs. "low") phenomenologically significant levels of PTSD severity; future studies with larger sample size could explore these associations with more than two levels. The data may be subject to social desirability bias despite our best efforts to hire seasoned interviewers and standardize training across time. With the exception of the PCL-5, the survey was

interviewer-administered thus some prevalence and cumulative incidence estimates may be underestimated; higher reports may arise from the use of self-administered survey such as Audio Computer-Assisted Self Interview (ACASI). A comparison of these data with data from a larger FSW cohort in Baltimore (led by the senior author), which utilizes ACASI and is currently enrolling participants, is planned to assess the potential for ascertainment bias.

Future studies should include more than two assessments of PTSD over time, and more in-depth measures for trauma severity, frequency, co-occurrence and number of perpetrators.[12] The role of psychosocial and cognitive factors associated with trauma and substance use such as resilience has been studied among survivors of the 9/11 terrorist attack in New York City,[33] and would be an important contribution to the FSW literature.

Despite the study limitations, the longitudinal nature of the study in a hard-to-reach population, the robust measure of accumulated violence and PTSD symptoms and the study findings add to the nascent literature on mental health among FSW and other high-trauma populations in the U.S. and highlights the critical role of cumulative violence in these women's lives. Trauma and PTSD were pronounced with over 40% recently experiencing violence perpetrated by clients, police or intimate partners during follow-up, and half experiencing persistently high PTSD severity across a six month timespan despite the active provision of referrals to a range of health and social services, including violence shelters. Interdisciplinary research has the potential to increase the body of knowledge on this multifaceted topic. FSW face unique barriers to accessing support and justice; the development of trauma-informed interventions that are sensitive to the realities of these women's lives and work, and reduce the risk of violence and address co-morbid substance

use are urgently needed. Given the role of police officers in both perpetrating violence against FSW and concurrently shaping their access to safety and justice, efforts to engage the criminal justice system will likely be required in order to make a sustainable impact.

Table 13: Baseline characteristics of female sex workers (N=137) retained at 6 month follow-up in Baltimore, Maryland

	No. (%)
Total	137 (100.0)
Demographics and early experiences	
Age, mean (SD)	37.4 (8.7)
Race/ethnicity	
Non-Hispanic White	97 (70.8)
Non-Hispanic Black	26 (19.0)
Hispanic/Multiracial/Other	14 (10.2)
Did not complete high school	71 (51.8)
Legally unemployed	124 (91.2)
Sex work	
Minor at sex work entry (age <18)	25 (18.3)
Trafficked into sex work (e.g. coerced, misled, forced)	8 (5.8)
Years in street-based sex work: >5 years	80 (58.4)
Currently working seven days a week	87 (63.5)
Housing and drug use	
Homelessness, past 3 months	87 (55.8)
Heroin or cocaine use, past 3 months	132 (96.4)
Violence history	
Childhood sexual violence (age < 18) (n=134)	48 (35.8)
Childhood physical violence (age <18) (n=133)	61 (45.9)
Client violence: sexual	46 (33.6)
Client violence: physical	66 (48.5)
Police officer violence: sexual	5 (3.7)
Police officer violence: physical	37 (27.0)
Intimate partner violence: sexual	25 (18.7)
Intimate partner violence: physical	68 (50.8)
Baseline cumulative violence, median (IQR)	2 (1-3)

Figure 6: Box-and-whisker plots of PTSD scores measured at baseline and 6-month follow-up among street-based female sex workers (N=137) in Baltimore, Maryland

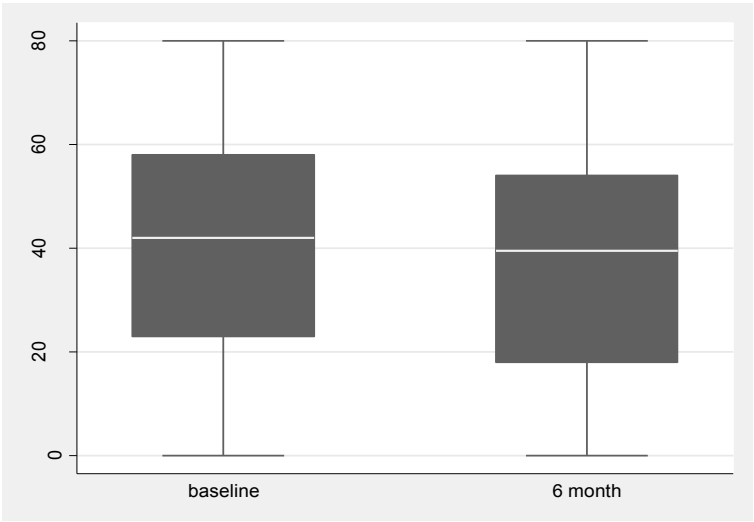


Figure 7: PTSD score change comparing baseline to 6-month follow-up among street-based female sex workers (N=137) in Baltimore, Maryland

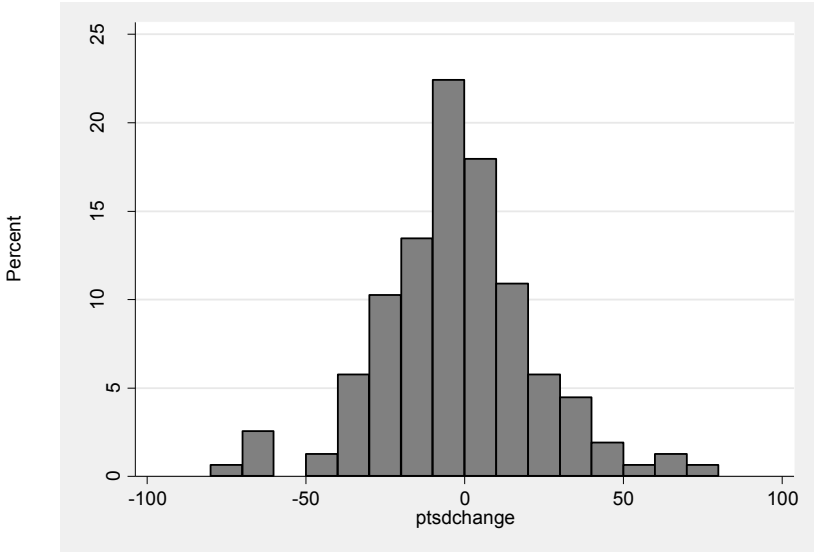
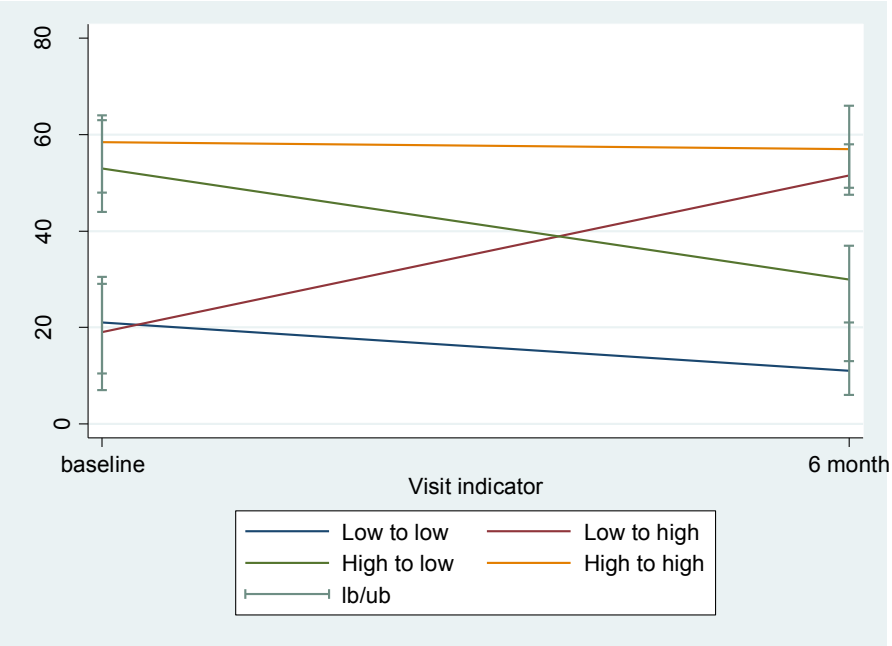


Figure 8: Changes in median PTSD severity comparing baseline to 6 month follow-up among street-based female sex workers (N=137) in Baltimore, Maryland



lb/ub indicate the lower and upper bounds of the interquartile range (IQR).

Table 14: Cumulative incidence of sexual and physical violence among street-based female sex workers (N=137) in Baltimore, Maryland

	Cumulative incidence n (%)
Recent violence	
Client violence	
Sexual	32 (23.5)
Physical	43 (31.6)
Intimate partner violence	28 (18.0)
Sexual	5 (3.8)
Physical	23 (17.2)
Police violence	10 (6.4)
Sexual	5 (3.7)
Physical	7 (5.2)
Pimp/manager violence	2 (1.3)
Sexual	0 (0.0)
Physical	2 (1.5)
Any recent violence	59 (43.1)
One type from above	19 (32.2)
Polyvictimization (≥2 types)	40 (67.8)
Newly exposed to recent violence (i.e. no history of baseline violence)	5 (8.5)

Table 15: Correlation matrix for recent violence indicators (N=137)

	Client sexual	Client physical	Police sexual	Police physical	Intimate partner sexual	Intimate partner physical
Client sexual	1.00					
Client physical	0.92	1.00				
Police sexual	1.00	0.55	1.00			
Police physical	0.51	0.60	0.85	1.00		
Intimate partner sexual	0.43	0.33	0.47	0.42	1.00	
Intimate partner physical	0.15	0.24	0.73	0.26	0.73	1.00

Table 16: Multivariate associations between violence, drug use and changes in PTSD level among female sex workers in Baltimore, Maryland (N=130) using multinomial logistic regression models

REF: Low stable: Group 1 (n=32)	Change in PTSD level from baseline to 6-month follow-up									Group comparisons (Wald tests)			Fit stat-istics
	High to Low: Group 2 (n=19)			Low to High: Group 3 (n=22)			High stable: Group 4 (n=64)			2 vs. 3	2 vs. 4	3 vs. 4	
	RR	95% CI	p	RR	95% CI	p	RR	95% CI	P	p	p	p	AIC
Baseline Model													319
Baseline cumulative violence^	1.67	1.01-2.74	**0.045**	1.54	0.91-2.61	0.108	2.51	1.61-3.90	**<0.001**	0.77	0.05	**0.04**	
Baseline age	1.03	0.96-1.10	0.462	0.94	0.87-1.02	0.128	1.00	0.94-1.06	0.994				
Baseline +Recent Violence Model													324
Baseline cumulative violence^	1.55	0.92-2.63	0.10	1.32	0.75-2.33	0.337	2.19	1.38-3.48	**0.001**	0.57	0.12	**0.04**	
Baseline age	1.02	0.95-1.09	0.56	0.94	0.87-1.02	0.131	1.00	0.95-1.06	0.915				
No recent violence	REF			REF			REF						
Recent violence: one type	0.20	0.02-1.89	0.16	0.51	0.08-3.17	0.469	0.92	0.25-3.39	0.902	0.17	0.48	0.51	
Recent violence: multiple types	2.05	0.31-13.3	0.454	4.08	0.63-26.4	0.14	3.97	0.76-20.8	0.102	0.30	0.39	0.97	
Baseline +Recent Violence +Drug Use Interaction Model													331
Baseline cumulative violence^	1.70	1.00-2.87	**0.049**	1.40	0.79-2.48	0.245	2.46	1.54-3.93	**<0.001**				
Baseline age	1.02	0.96-1.09	0.53	0.94	0.87-1.02	0.12	1.01	0.95-1.07	0.816				
Recent violence	0.40	0.02-10.32	0.579	2.64	0.13-55.7	0.532							
Reduced drug use* (bl to 6-mo)	REF			REF			REF						
No reduction (bl vs. 6-mo)	0.63	0.11-3.60	0.608	0.82	0.11-6.21	0.845	1.25	0.22-7.18	0.8				
Recent violence x drug use	1.94	0.06-64.6	0.711	0.44	0.02-12.0	0.625	1.34	0.07-25.8	0.847				

Low PTSD defined as PCL-5 total score<33; High PTSD defined as PCL-5 total score≥33
RR = Relative risk ratios
^ Number of childhood or adulthood sexual or physical violence types at baseline
*Reduction in frequency of heroin/cocaine use comparing baseline and 6-month visits

References

1. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of general psychiatry.* 1998;55(7):626-632.
2. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub; 2013.
3. Breslau N. Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. In: SAGE Publications Sage CA: Los Angeles, CA; 2002.
4. Santiago PN, Ursano RJ, Gray CL, et al. A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. *PloS one.* 2013;8(4):e59236.
5. Breslau N, Chilcoat HD, Kessler RC, Peterson EL, Lucia VC. Vulnerability to assaultive violence: further specification of the sex difference in post-traumatic stress disorder. *Psychological medicine.* 1999;29(4):813-821.
6. Ullman SE, Relyea M, Peter-Hagene L, Vasquez AL. Trauma histories, substance use coping, PTSD, and problem substance use among sexual assault victims. *Addictive behaviors.* 2013;38(6):2219-2223.
7. Dworkin ER, Mota NP, Schumacher JA, Vinci C, Coffey SF. The unique associations of sexual assault and intimate partner violence with PTSD symptom clusters in a traumatized substance-abusing sample. *Psychological trauma: theory, research, practice, and policy.* 2017;9(4):500.
8. Iverson KM, Vogt D, Maskin RM, Smith BN. Intimate Partner Violence Victimization and Associated Implications for Health and Functioning Among Male and Female Post-9/11 Veterans. *Med Care.* 2017;55 Suppl 9 Suppl 2:S78-S84.
9. Breslau N, Davis GC, Andreski P, Peterson E. Traumatic events and posttraumatic stress disorder in an urban population of young adults. *Archives of general psychiatry.* 1991;48(3):216-222.
10. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of general psychiatry.* 1995;52(12):1048-1060.
11. Shalev AY, Freedman S, Peri T, et al. Prospective study of posttraumatic stress disorder and depression following trauma. *American Journal of psychiatry.* 1998;155(5):630-637.
12. Scott-Storey K. Cumulative abuse: do things add up? An evaluation of the conceptualization, operationalization, and methodological approaches in the study of the phenomenon of cumulative abuse. *Trauma, Violence, & Abuse.* 2011;12(3):135-150.
13. Hedtke KA, Ruggiero KJ, Fitzgerald MM, et al. A longitudinal investigation of interpersonal violence in relation to mental health and substance use. *Journal of Consulting and Clinical Psychology.* 2008;76(4):633.
14. Deering KN, Amin A, Shoveller J, et al. A systematic review of the correlates of violence against sex workers. *Am J Public Health.* 2014;104(5):e42-54.
15. Vanwesenbeeck I. Another decade of social scientific work on sex work: a review of research 1990-2000. *Annu Rev Sex Res.* 2001;12:242-289.
16. Surratt HL, Kurtz SP, Weaver JC, Inciardi JA. The Connections of Mental Health Problems, Violent Life Experiences, and the Social Milieu of the "Stroll" with the HIV Risk Behaviors of Female Street Sex Workers. *Journal of Psychology & Human Sexuality.* 2005;17(1-2):23-44.
17. Surratt HL, Inciardi JA, Kurtz SP, Kiley MC. Sex work and drug use in a subculture of violence. *Crime & Delinquency.* 2004;50(1):43-59.

18. Coetzee J, Gray G, Jewkes R. Prevalence and patterns of victimization and polyvictimization among female sex workers in Soweto, a South African township: a cross-sectional, respondent-driven sampling study. *Global health action.* 2017;10(1):1403815.
19. Shannon K, Strathdee SA, Goldenberg SM, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet.* 2015;385(9962):55-71.
20. Krusi A, Kerr T, Taylor C, Rhodes T, Shannon K. 'They won't change it back in their heads that we're trash': the intersection of sex work-related stigma and evolving policing strategies. *Sociol Health Illn.* 2016;38(7):1137-1150.
21. Roxburgh A, Degenhardt L, Copeland J. Posttraumatic stress disorder among female street-based sex workers in the greater Sydney area, Australia. *BMC Psychiatry.* 2006;6:24.
22. Farley M, Barkan H. Prostitution, violence, and posttraumatic stress disorder. *Women Health.* 1998;27(3):37-49.
23. Argento E, Muldoon KA, Duff P, Simo A, Deering KN, Shannon K. High prevalence and partner correlates of physical and sexual violence by intimate partners among street and off-street sex workers. *PLoS One.* 2014;9(7):e102129.
24. Stoltz J-AM, Shannon K, Kerr T, Zhang R, Montaner JS, Wood E. Associations between childhood maltreatment and sex work in a cohort of drug-using youth. *Social science & medicine.* 2007;65(6):1214-1221.
25. Morris MD, Lemus H, Wagner KD, et al. Factors associated with pathways toward concurrent sex work and injection drug use among female sex workers who inject drugs in northern Mexico. *Addiction.* 2013;108(1):161-170.
26. Liu S-H, Srikrishnan A, Zelaya CE, Solomon S, Celentano DD, Sherman SG. Measuring perceived stigma in female sex workers in Chennai, India. *AIDS care.* 2011;23(5):619-627.
27. McCauley JL, Killeen T, Gros DF, Brady KT, Back SE. Posttraumatic stress disorder and co- occurring substance use disorders: Advances in assessment and treatment. *Clinical Psychology: Science and Practice.* 2012;19(3):283-304.
28. Weaver TL, Gilbert L, El-Bassel N, Resnick HS, Noursi S. Identifying and intervening with substance-using women exposed to intimate partner violence: phenomenology, comorbidities, and integrated approaches within primary care and other agency settings. *Journal of women's health.* 2015;24(1):51-56.
29. Weathers FW, Litz BT, Keane TM, Palmieri PA, Marx BP, Schnurr PP. The PTSD Checklist for DSM-5 (PCL-5). . 2013.
30. Straus MA, Hamby SL, Boney-McCoy S, Sugarman DB. The revised conflict tactics scales (CTS2) development and preliminary psychometric data. *Journal of family issues.* 1996;17(3):283-316.
31. Shannon K, Kerr T, Strathdee SA, Shoveller J, Montaner JS, Tyndall MW. Prevalence and structural correlates of gender based violence among a prospective cohort of female sex workers. *BMJ.* 2009;339:b2939.
32. Baltimore Sun. Baltimore Homicides. 2017; http://data.baltimoresun.com/news/police/homicides/. Accessed Nov 1, 2017.
33. Bonanno GA, Galea S, Bucciarelli A, Vlahov D. What predicts psychological resilience after disaster? The role of demographics, resources, and life stress. *Journal of consulting and clinical psychology.* 2007;75(5):671.

CHAPTER FIVE: DISCUSSION

Overview

Violence against women and girls remains a pressing public health issue globally; more than one in three women are exposed to sexual or physical violence in their lifetime, mostly perpetrated by men.[1,2] Despite the existing laws against sexual and physical violence, perpetrators remain largely hidden and survivors are stigmatized. Efforts to address the gender-based violence epidemic has received renewed interest in the past year following the growth of the historic #MeToo movement, which along with many other coordinated global campaigns has helped to propel socio-cultural change across communities, institutions and countries in recent years to improve access to prevention, treatment, safety and justice around gender-based violence for the millions of survivors and victims worldwide. The movement has also raised important dialogue around legal, policy and sociocultural issues that are more resistant to change (e.g., victim-blaming, social expectations around sexual consent), which are consistent with theories that recognize gender as a powerful social structure.[3]

The goal of this dissertation was to investigate the cross-sectional and longitudinal roles of exposure to dimensions of violence, chronic strain and substance use on PTSD symptoms among street-based FSW in an urban U.S. setting. Street-based FSW are among one of the most structurally vulnerable, socially marginalized and underserved members of society, and only a small body of mental health literature exists among this population.[4-7] While FSW experience many other mental health morbidities,[8] PTSD was chosen due to its inextricable link with trauma, which is prevalent among this population. Our research was informed by theories and prior work from the fields of sociology and public health with the recognition that the individual agency of FSW in protecting their own health is

shaped by broader social and structural forces and the behaviors of others in the occupational and personal domains, particularly men who hold positions of social, economic and legal power.[3,9-11]

The Sex Workers and Police Promoting Health in Risky Environments (SAPPHIRE) study is one of the first U.S.-based observational prospective cohort studies of street-based FSW. Two-hundred and fifty cisgender FSW were recruited from a wide range of street-based locations across Baltimore city, and interviewed every three months over a one-year period. The study team applied a rigorous sampling methodology that triangulated time-location data from a year-long ethnography with the Baltimore City Police Department and several secondary data sources. Our survey ascertained the prevalence of PTSD symptoms and exposure to sexual and physical violence by perpetrator group using robust measures. Retaining participants in follow-up was challenging, however after accounting for exogenous factors (e.g., incarceration, drug rehabilitation, and death), study retention was 74% after six months. This rich longitudinal dataset was leveraged to achieve the aims of this dissertation; the findings are discussed in the following paragraphs. We caution that the findings, particularly the prevalence estimates that were observed in this study, are unlikely to be generalizable to FSW who do not engage in street-based sex work; prior research has established the unique and heightened vulnerabilities associated with street-based sex work.[4]

In investigating the relationship between various dimensions of violence and PTSD symptoms among street-based FSW, we observed synergy between the results from each aim, which added to our understanding of these nuanced relationships. In aim 1, we utilized the DSM-5 symptom criteria (criterion B to E) to model the presence or absence of PTSD

symptoms. However, this approach did not differentiate between lower and higher PTSD severity nor did not provide insights into the health of the substantial proportion of FSW categorized as having subsyndromal PTSD (i.e., not meeting full DSM-5 symptom criteria), which led us to utilize a continuous dependent variable i.e., overall PTSD severity in the Aim 2 analysis. Aim 2 also incorporated the concepts of chronic strain and substance use into these models. During our Aim 2 examination of the bivariate associations between PTSD symptoms and the four types of violence (CSV, ASV, CPV, APV), we observed that each violence type was significantly associated with PTSD severity but given the high degree of multiple exposures to violence over the life course in this population, simply entering all four variables into a multivariate model only represented independent associations, even in the presence of interaction terms for sexual and physical revictimization; subsequently, we chose to also model cumulative effects of violence. The cumulative violence construct provided the most wholistic understanding of these nuanced dynamics and fidelity to the phenomenology of violence among these women across all three dissertation aims. The prospective nature of the study allowed us to characterize changes in PTSD severity over time in Aim 3 with a focus on recent violence and substance use, after adjusting for baseline cumulative violence.

All three aims highlight the gendered nature of violence across the life course, which impact the health of street-based FSW and many women worldwide. This research also highlights the challenges we face in reducing the global morbidity and mortality associated with violence against FSW and women.

Summary of findings

Broadly, the goal of Aim 1 was to characterize the clustering of PTSD symptoms, identify co-occurring conditions (i.e., homelessness, depression, and substance use) and model the bivariate associations between DSM-5 defined PTSD symptom clusters and lifetime violence types among FSW in Baltimore, Maryland (N=230). Most (61%) FSW exhibited PTSD symptoms using a validated cut-off (PCL-5 $\geq$ 33), and the majority had never been clinically diagnosed. Analysis of the individual-level patterns in PTSD symptom clusters elucidated that despite having moderate to severe PTSD symptoms almost 30% were subsyndromal (i.e. did not meet DSM-5 symptom criteria). High co-occurrence (40-51%) was observed between the presence of PTSD symptoms and lifetime interpersonal violence, recent homelessness, depression symptoms and drug use, and most women demonstrated multiple co-occurring conditions. Within Aim 1, we also examined the psychometric properties of the PCL-5, a validated scale used to measure past month PTSD symptoms. Two models were supported using Confirmatory Factor Analysis using these data; a four-factor DSM-5 model and a five-factor DSM-IV dysphoric arousal model of PTSD. The analysis also identified three PTSD symptoms that had lower loadings (amnesia, hypervigilance and sleep), which may be influenced by substance use and sleep disturbances associated with sex work and homelessness.

Aim 1 also examined the associations between four major types of violence over the life course (CSV, CPV, ASV, APV) and four DSM-5 defined PTSD symptom clusters (criterion B-E) were examined using regression analysis. All four types of violence were significantly associated with each PTSD criterion. The violence types were totaled to elucidate the role of "cumulative violence." Across all four PTSD criteria, cumulative

violence had a dose-response relationship with each PTSD criteria, comparing FSW who were exposed to two, three, or four types of violence, to FSW exposed to no violence.

Aim 2 provided insights into the relationships between revictimization, cumulative violence and PTSD severity among Baltimore FSW (N=230) in the context of recent chronic strain and substance use. FSW had strikingly high lifetime histories of sexual and physical violence perpetrated by male clients, police officers and intimate partners, as well as PTSD severity levels three-fold higher than that observed among veterans of war. This study was one of the first to document revicmization and polyvictimization rates among FSW, which are also higher than reported in other populations. Multivariate analyses revealed strong and statistically significant baseline associations between PTSD severity and sexual violence (childhood and adulthood) and marginally significant associations with physical violence (childhood and adulthood). Interestingly, sexual and physical revictimization did not have a significant association with PTSD severity after adjusting for main effects. The cumulative violence model demonstrated a non-linear dose-response relationship between PTSD severity and the number of lifetime violence types reported. Unlike the results of Aim 1 that modeled PTSD symptoms as a binary outcome, exposure to one type of violence conferred higher PTSD levels when modeled as a continuous variable. In both multivariate models, binge drinking (daily/almost daily) was strongly and consistently associated with higher PTSD severity. Food insecurity, one of the chronic strain measures that was included in the analysis, was associated in bivariate analysis but did not remain significant in the presence of violence and binge drinking. The models did not account for other co-morbidities and potential confounders.

Aim 3 was a novel study examining the longitudinal impact of cumulative violence and polyvictimization on changes in PTSD severity among the subset of SAPPHIRE participants (N=130). Half (49%) of FSW retained in six months of study follow-up had persistently high PTSD symptoms over this period. We used multinomial regression to model the relationship between baseline cumulative violence, recent (past six months) violence and changes in PTSD over a six-month period. Higher baseline cumulative violence placed women at higher risk of having high PTSD severity at baseline, most of whom had persistently high PTSD after 6 months. We hypothesized that having high PTSD severity at six months regardless of baseline PTSD levels would be driven by recent polyvictimization, however, these associations did not reach statistical significance, which was perhaps due to the modest sample size. Structural equation modeling is an alternative model that could be used to investigate these associations. Changes in drug use frequency did not appear to moderate the observed associations, although studies with larger sample sizes and longer follow-up periods are likely needed in order to elucidate the complex relationship between cumulative exposures to violence and drug use.

Study implications

This study was conducted using data from an observational prospective cohort study; our data show that in the absence of trauma or mental health interventions, violence and PTSD levels remain high and relatively stable among street-based FSW over six months of follow-up. The most recent epidemiologic study of U.S. street-based FSW was conducted over a decade ago in Miami, Florida.[5] Their findings were remarkably similar to our findings; the majority were unstably housed, were substance users, exposed to

childhood abuse (53% were sexually abused, 51% were physical abused), recently exposed to violence (71% in the past 3 months), and had symptoms of acute traumatic stress. Despite the differences between these studies in setting, racial composition, eligibility criteria and trauma/mental health scales employed, the comparability of these findings highlight the unmet health needs of urban street-based FSW in the U.S., particularly around trauma, vulnerability to chronic strain, substance use and mental health.

The absence of FSW in the modern mental health literature is likely explained by their highly stigmatized and marginalized status throughout society. For example, U.S.-based researchers have noted the "invisibility" of sex workers in national health surveillance systems despite the evident health needs among this population, and have reported employing self-censorship in grant applications in order to include sex workers in their research.[12,13]

Screening for trauma and mental health symptoms

By using standardized measures of violence across multiple perpetrator groups, we were able to ascertain the relative contribution of each perpetrator group in enacting violence against FSW in our study, adding nuance to the literature among this marginalized population. Our simplified version of the Revised Conflict Tactics Scale[14] reduced the burden of survey items while capturing the most severe forms of trauma i.e., exposure to sexual and physical violence, by key perpetrator types. We measured these exposures over time, which allowed us to examine more complex factors such as revictimization and cumulative violence - a novel contribution to the FSW literature.

To measure PTSD symptoms, we used the PCL-5, a newly validated scale, which allowed us to directly compare the prevalence of PTSD symptoms in our sample to other

widely-studied populations including veterans. PTSD was originally classified as an anxiety disorder in the 1990's but reclassified under a new category called Trauma- and Stressor-Related Disorders along with other disorders including Acute Stress Disorder.[15]

While this dissertation focused on PTSD symptoms, FSW experience a range of symptoms associated with poor mental health such as depression and anxiety, as observed among many other high-trauma populations, which will need to be addressed in future research.[8] The association between specific symptoms and psychosocial functioning could also yield insights into the prioritization of mental health services in the context of multiple "competing" comorbidities. Nevertheless, our data could be used to support a reduced form of the PCL-5 in measuring PTSD symptoms. Given that exposure to trauma (criterion A) increases the risk of disorders other than PTSD (e.g., depression, anxiety and SUD), the requisite traumatic event criterion may not be necessary particularly in light of specificity issues discussed elsewhere.[16] Aim 1 showed that excluding criterion D (negative cognitions and mood), a criterion which has raised controversy due to its overlap with symptoms of depression, would increase the percentage who screen positive for PTSD symptoms by 3.9%. We observed high correlation between criterion D symptoms and depression symptoms measured using the CES-D (coefficient=0.64). Factor analysis could be used to remove items that do not contribute to explaining the overall variance in a future analysis. In fact, some researchers call for the reduction of the PTSD diagnostic criteria by excluding criterion D symptoms and focusing on the "core" symptoms of PTSD that best differentiate PTSD from other mental health disorders.[16] Others support transdiagnostic classification based on data-driven approaches rather than specific DSM-defined disorder types (e.g., assessment of depression, anxiety and stress symptoms), and

targeting common symptoms or transdiagnostic processes in delivering interventions, which remains an active area of research.[17,18] Indeed, transdiagnostic approaches may have clinical utility among FSW who often have multiple mental health diagnoses and comorbidities.

Addressing substance use comorbidity

Substance use had a prominent role among virtually all FSW in this study. Notably, many FSW with PTSD symptoms also report comorbid substance use; there are compelling theories that point to the common social and structural roots between these two conditions as well as the higher rates of trauma exposure among patients with independent and co-morbid PTSD and SUD.[19,20] In some cases, drugs and alcohol may be used to self-medicate from prior trauma and PTSD [21]; previous studies have shown that trauma and PTSD are more likely to occur before rather than after the onset of SUD among women, which corroborates the "self-medication" theory.[21-24] PTSD-SUD comorbidity is important to address among FSW as it is often associated with poorer prognosis.[25] The evidence base for treating patients with comorbid PTSD-SUD is relatively nascent with study retention being a key issue.[14] Nevertheless, concurrent rather than sequential PTSD-SUD treatment appears to be most effective in addressing comorbidity.[14]

Frequent binge drinking emerged as a key correlate of PTSD severity, corroborating previous research.[26] Women are more likely to use alcohol to cope with trauma and PTSD symptoms than men, a type of avoidance coping.[27] Addressing risky alcohol use among this population is warranted, given its own health consequences as well as links to the risk of revictimization.[28] While substance use may help survivors cope with PTSD symptoms in the short-term, the effects have been shown to aggravate symptoms in

the long-term.[27] Binge drinking behaviors among intimate partners plays a role in perpetration thus targeting male partners in interventions may be beneficial.[29] Our research supports the integration of trauma and substance use interventions targeting FSW.

Trauma-informed, tailored and integrated interventions are needed

This dissertation underscores the importance of targeted interventions for street-based FSW that address a range of co-morbidities, and that are trauma-informed and integrated. Attention to the structural vulnerability of FSW and the ramifications of the social structure of gender on these women's lives will likely be useful in improving health outcomes at the population-level. The key aspects to consider in attending to trauma among FSW are violence prevention and safety, both in the occupational and personal domains, post-trauma intervention, access to mental health treatment, and justice.

The high rates of revictimization and recent violence observed among street-based FSW demonstrate an urgent need for violence prevention and safety programs. In developing safety interventions against violence, researchers and service providers should be aware that violence is perpetrated by a variety of groups in the occupational and personal domains, particularly clients and intimate partners. This dissertation focused on a relatively narrow and severe form of abuse; ideally, interventions should aim to address earlier signs of abuse such as emotional abuse and controlling behaviors. For many FSW, sex work is their main source of income thus interventions that reduce the risks associated with sex work are also necessary; a local example of a brief intervention has been published recently.[30] FSW, particularly those who have successfully avoided exposure to violence, could be engaged in the process to develop harm reduction strategies for street-based sex workers. There are several known modifiable risk factors of gender-based violence

perpetration (e.g., binge drinking and violent social norms towards women) that could be tailored in future FSW interventions.[29] Other broad social and structural factors that can help to reduce the harms associated with violence include societal efforts to reduce childhood abuse and to improve educational and employment opportunities at the population level.[31] However, some scholars caution that violence prevention and safety efforts among FSW are constrained by the legal framework of sex work criminalization.[32,33]

In order to be successful, all interventions and services must be confidential, non-stigmatizing and sensitive to FSW's complex health and social service needs, particularly in settings where sex work and drug use remain criminalized. Given the cumulative impact of violence, healthcare providers aiming to address violence among patients engaged in sex work should use comprehensive measures of trauma (e.g., measures that capture exposures over the life course and across violence type). Given the criminalized status of their work, FSW may fear disclosing their engagement in sex work and client violence to healthcare providers, which may be a challenge to service delivery. This may entail developing trainings for healthcare providers with the input of current or former FSW to improve their cultural sensitivity when serving FSW.

This study was the first to quantitatively examine the role of chronic strain (i.e., homelessness, financial insecurity and food insecurity) in relation to PTSD symptoms and substance use among FSW. While a previous trauma is necessary for a PTSD diagnosis, most of those who are trauma-exposed do not develop chronic PTSD.[34] Existing research emphasize the role of chronic strain on the development of depression and addiction[35,36]; less epidemiologic work has been conducted on the potential etiological link between

chronic strain and PTSD. Chronic strain factors were experienced by virtually all FSW in our study. This was expected given that these factors overlap with markers of structural vulnerability, which is observed to be most extreme among street-based FSW. In Aim 2, we also observed cross-sectional associations between chronic strain factors and PTSD severity though the associations were not significant in the presence of other variables. The chronicity of trauma and stress in these women's lives provides a challenge to modeling associations over time; intervention-based research (e.g., the impact of providing affordable housing) may be required to measure the impact of these exposures on the mental health of FSW.

Given the high comorbidity between mental health and substance use disorders as well as multiple service needs, models of integrated care for FSW have been developed. The SPARC Center, a community-level intervention in Baltimore that is being implemented and evaluated through a grant from the National Institutes of Health (R01; PI Sherman), opened its doors in 2017. The SPARC Center is a trauma-informed, integrated drop-in center that has been established in an under-resourced area of the city with a high concentration street sex work activity. The Center provides a range of services to women including counseling, case management, legal services, reproductive health services, showers, lockers, as well as a buprenorphine program for opioid addiction. Peer outreach workers conduct street outreach to engage the most vulnerable FSW.

Prioritizing programs to implement can be a challenge, particularly among populations with considerable health and social needs, and in limited resource settings; a health assessment of the target population and obtaining input from the affected community could be useful to ensure that programs meet the most urgent needs while being attentive

to individual agency. Supporting attainment of basic human rights (e.g., equality, safety, medical care and housing) could be a useful goal of integrated programs.[37] Mental health services could certainly help empower FSW with positive coping skills, resilience, that likely will have a downstream impact on long-term psychosocial functioning.

It is also notable that FSW face unique barriers to accessing services and receiving justice given the criminalization of sex work and drug use; decriminalization could have a profound impact on reaching these women, who remain one of the most marginalized groups within society. Improved provision of mental health services that are trauma-informed within the criminal justice setting as well as linkage to post-release mental health care among FSW should be considered. Police have roles in perpetrating violence against FSW and concurrently shaping their access to safety and justice.[38,39] Policing may also indirectly impact perpetration of violence against FSW by other parties.[33] Efforts to engage police departments in harm reduction strategies will likely be required in order to make a sustainable impact. Several police-level interventions have been developed to alleviate the harms associated with criminal justice-approaches to sex work.[38,40] Locally, data collected from the SAPPHIRE study will be used to design a police-level intervention at the Baltimore City Police Department.

Study strengths and limitations

Strengths

There are many strengths to the current study. Owing to their marginalization from society, street-based FSW are a hard-to-reach population. The SAPPHIRE study is one of the first prospective cohort studies of FSW conducted in the U.S. setting and participants

were engaged over 12 months of follow-up. Targeted sampling, supported by a year of formative ethnography and geospatial techniques, was used to obtain a non-convenience sample.

The current study is the first to concurrently examine the epidemiology of violence and PTSD symptoms over time among street-based FSW. The longitudinal nature of the dataset allowed for measurement of revictimization rates and start to disentangle temporality of relationships; it also allowed investigation of the cumulative incidence of violence, which is rare in the FSW literature. Our findings demonstrated the recurring and pervasive nature of violence in these women's lives. There were no baseline differences in PTSD severity between women who were retained after six months (Supplementary Table 2), which strengthens our confidence in the PTSD change estimates over time. The robust measure of accumulated violence, alcohol use and PTSD symptoms increased the validity of the findings. Our study added not only to the nascent literature on mental health among FSW, but informs research among high-trauma female samples by highlighting the critical role of cumulative polyvictimization in the etiology of PTSD in these women's lives, which remains a nascent field of research. Lastly, the interdisciplinary nature of the study was critical to gaining a broad understanding of the associations examined.

Limitations

This research is also subject to limitations. It is likely that our baseline sample was affected by survivor bias given the high violence, homicide and mortality rates among FSW.[41,42] For example, given that a large proportion of female homicides are committed by intimate partners, it is plausible that we underestimated the prevalence of intimate partner violence since those FSW may have been unable to be recruited.[43] Our study may

have been affected by the healthy worker effect; it is plausible that FSW exposed to high trauma and PTSD severity may become unable to function and work. Women who work more frequently or remain in sex work over a longer period of time may be over-represented due to a higher probability of encountering our study staff. Women who have a higher volume of clients (and therefore not enough time to spend more than an hour on a study van) may be underrepresented in the SAPPHIRE cohort though efforts were made to recruit women at all hours of the day, including the hours prior to and following the busiest hours for FSW.

The majority of our participants were racially white, which contrasts with the racial composition of Baltimore city which consists of a majority black population; black FSW may have been underrepresented in our study due to higher rates of incarceration, and relatedly, a reliance on indoor or online sex work due to fear of arrest rather than outdoor sex work.

Due to loss to follow-up, our analytic sample size in manuscript three was modest, which may have driven the lack of significance of the recent violence associations and contributed to bias of the results. Loss to follow-up (LTFU) appeared to be influenced by age (i.e., younger age and homelessness were salient factors associated with LTFU; see supplementary tables S1 and S2). In the future, propensity scores and inverse probability weighting could be useful to tackle confounding and biases; imputation methods could be applied to address data missingness.

The data may be subject to social desirability bias despite our best efforts to hire seasoned interviewers and standardize training across time. However, interviewer-administered surveys allowed an opportunity for women to disclose trauma experiences

(many for the first time), and provision of post-survey support and tailored referrals. In fact, disclosure rates for client, police and intimate partner violence were high as evident by the low percentage of refused to answer responses for these items. We observed higher difficulties disclosing childhood abuse even despite these items being self-reported rather than interviewer-administered.

The models and interpretation are also subject to unmeasured confounding; this study did not examine the influence of non-violent traumas or other adult perpetrators of violence other than clients, police, pimps and intimate partners. While the violence exposures included in our study are the dominant forms among FSW according to the published literature,[32] we certainly received anecdotal reports of recent assault from family members, neighbors and strangers. We did not measure other important confounders including perceived life threat,[44] and access to mental health care. The study may only be generalizable to urban street-based cisgender FSW in comparable contexts.

Transgender FSW were recruited within the SAPPHIRE study, however they had several key socio-demographic, structural vulnerability and substance use differences. Subsequently, this subgroup were not included in the current analysis though separate comparative analyses would certainly contribute to the literature.

Though this research focused on PTSD symptoms, it is established that FSW experience a range of mental health conditions such as depression, anxiety disorders, bipolar disorders and personality disorders;[8] the phenomenologic significance of these other conditions following exposure to trauma should also be explored, and their influence on psychosocial functioning, in order to develop a wholistic understanding of the impact of trauma on mental health.

Future research

Future studies of PTSD severity among FSW should include survey items that measure violence from other forms of perpetrators (e.g., strangers, neighbors) and other forms of trauma (e.g., witnessing violence). Longitudinal studies should include more than two assessments of mental health symptoms over time using a broader range of mental health symptoms in order for increase the robustness of the statistical inferences that can be drawn, and could include in-depth measures for trauma severity, frequency, co-occurrence and number of perpetrators.[45] Methods of locating and interviewing women who are incarcerated could be helpful in increasing retention in these studies given that this was the main reason for LTFU. Studies with larger sample sizes and higher retention rates would improve statistical power in modeling more complex phenomena, including latent variables, effect modification and mediation.

Interdisciplinary research has the potential to increase the body of knowledge on this multifaceted topic. Unexplored areas of research include identifying factors associated with PTSD resilience (i.e., FSW with low and stable PTSD levels despite experiencing violence). The role of indirect trauma, one's personal sense of control, coping skills (e.g., avoidant coping), negative post-trauma social reactions, and social support have been shown to play a role in the development of PTSD among other female populations.[46-48] While markers of chronic strain were included in the dissertation research, a more nuanced understanding of occupational stress and methods to mitigate chronic strain from sex work could be helpful.[33] Interventions targeting substance use (e.g., binge drinking) and overall mental health could be implemented and evaluated though identifying and reducing barriers to service access such as healthcare stigma must first be addressed. Measuring the

impact of interventions that target PTSD symptoms on revictimization and psychosocial functioning may improve our understanding of this condition.

Restrictions of funding for research on FSW in the U.S. setting and regressive policies surrounding sex work are prominent reasons for the sustained lack of published data on the health and wellbeing of cisgender and transgender FSW; the exclusion of FSW from national surveillance has also been cited as a barrier to understanding and meeting their health needs.[12,49]

Conclusion

Women and girls are at risk of violence throughout their lives. Our study of street-based FSW, a highly marginalized urban population, demonstrates that strategies targeting violence risk reduction and PTSD symptoms will need to occur across occupational and personal domains and utilize a life course approach. Both prevention and treatment strategies that are attentive to multiple co-morbidities and the structural vulnerability of these women are urgently required. Individual-level strategies alone will likely not be effective given the importance of interpersonal dynamics, and the broader social, cultural and structural forces influencing the safety and health of FSW. Engagement of the police may hold potential for a multi-sectoral response, though the human rights violations that they perpetrate must be addressed. Innovation, investment and policy reform will likely be needed in order to make a sustainable impact on the prevention and treatment of trauma among street-based FSW.

References

1. Devries KM, Mak JY, García-Moreno C, et al. The global prevalence of intimate partner violence against women. *Science.* 2013;340(6140):1527-1528.
2. World Health Organization. Global and regional estimates of violence against women: prevalence and health effects of intimate partner violence and non-partner sexual violence. World Health Organization; 2013.
3. Connell RW. Gender and power: Society, the person and sexual politics. Stanford University Press; 1987.
4. Vanwesenbeeck I. Another decade of social scientific work on sex work: a review of research 1990-2000. *Annu Rev Sex Res.* 2001;12:242-289.
5. Surratt HL, Kurtz SP, Weaver JC, Inciardi JA. The Connections of Mental Health Problems, Violent Life Experiences, and the Social Milieu of the "Stroll" with the HIV Risk Behaviors of Female Street Sex Workers. *Journal of Psychology & Human Sexuality.* 2005;17(1-2):23-44.
6. Roxburgh A, Degenhardt L, Copeland J. Posttraumatic stress disorder among female street-based sex workers in the greater Sydney area, Australia. *BMC Psychiatry.* 2006;6:24.
7. Farley M, Cotton A, Lynne J, et al. Prostitution and trafficking in nine countries: An update on violence and posttraumatic stress disorder. *Journal of Trauma Practice.* 2004;2(3-4):33-74.
8. Puri N, Shannon K, Nguyen P, Goldenberg SM. Burden and correlates of mental health diagnoses among sex workers in an urban setting. *BMC Women's Health.* 2017;17.
9. Giddens A. The constitution of society: Outline of the theory of structuration. Univ of California Press; 1984.
10. Rhodes T, Wagner K, Strathdee SA, Shannon K, Davidson P, Bourgois P. Structural violence and structural vulnerability within the risk environment: theoretical and methodological perspectives for a social epidemiology of HIV risk among injection drug users and sex workers. In: *Rethinking social epidemiology.* Springer; 2012:205-230.
11. Maher L, Curtis R. Women on the edge of crime: Crack cocaine and the changing contexts of street-level sex work in New York City. *Crime, Law and Social Change.* 1992;18(3):221-258.
12. Decker MR, Beyrer C, Sherman SG. Ending the invisibility of sex workers in the US HIV/AIDS surveillance and prevention strategy. *AIDS.* 2014;28(15):2325-2327.
13. Kempner J. The Chilling Effect: How Do Researchers React to Controversy? *PLoS Medicine.* 2008;5(11).

14. Straus MA, Hamby SL, Boney-McCoy S, Sugarman DB. The revised conflict tactics scales (CTS2) development and preliminary psychometric data. *Journal of Family Issues.* 1996;17(3):283-316.

15. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®).* American Psychiatric Pub; 2013.

16. Brewin CR, Lanius RA, Novac A, Schnyder U, Galea S. Reformulating PTSD for DSM-V: life after Criterion A. *J Trauma Stress.* 2009;22(5):366-373.

17. Bolton P, Lee C, Haroz EE, et al. A transdiagnostic community-based mental health treatment for comorbid disorders: development and outcomes of a randomized controlled trial among Burmese refugees in Thailand. *PLoS Medicine.* 2014;11(11):e1001757.

18. Grisanzio KA, Goldstein-Piekarski AN, Wang MY, Rashed Ahmed AP, Samara Z, Williams LM. Transdiagnostic Symptom Clusters and Associations With Brain, Behavior, and Daily Function in Mood, Anxiety, and Trauma Disorders. *JAMA Psychiatry.* 2018;75(2):201-209.

19. Dasgupta N, Beletsky L, Ciccarone D. Opioid Crisis: No Easy Fix to Its Social and Economic Determinants. *American Journal of Public Health.* 2018;108(2):182-186.

20. Ozer EJ, Best SR, Lipsey TL, Weiss DS. Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychol Bull.* 2003;129(1):52-73.

21. Stewart SH, Pihl RO, Conrod PJ, Dongier M. Functional associations among trauma, PTSD, and substance-related disorders. *Addictive Behaviors.* 1998;23(6):797-812.

22. Olff M. Sex and gender differences in post-traumatic stress disorder: an update. *European Journal of Psychotraumatology.* 2017;8(sup4):1351204.

23. Olff M, Langeland W, Draijer N, Gersons BP. Gender differences in posttraumatic stress disorder. *Psychological Bulletin.* 2007;133(2):183.

24. Khantzian EJ. The self-medication hypothesis of addictive disorders: focus on heroin and cocaine dependence. In: *The Cocaine Crisis.* Springer; 1987:65-74.

25. Flanagan JC, Korte KJ, Killeen TK, Back SE. Concurrent Treatment of Substance Use and PTSD. *Curr Psychiatry Rep.* 2016;18(8):70.

26. McCauley JL, Killeen T, Gros DF, Brady KT, Back SE. Posttraumatic stress disorder and co- occurring substance use disorders: Advances in assessment and treatment. *Clinical Psychology: Science and Practice.* 2012;19(3):283-304.

27. Jacobsen LK, Southwick SM, Kosten TR. Substance use disorders in patients with posttraumatic stress disorder: a review of the literature. *American Journal of Psychiatry.* 2001;158(8):1184-1190.

28. McCauley JL, Calhoun KS, Gidycz CA. Binge drinking and rape: A prospective examination of college women with a history of previous sexual victimization. *Journal of Interpersonal Violence.* 2010;25(9):1655-1668.

29. Heise L. What works to prevent partner violence? An evidence overview. 2011.

30. Decker MR, Tomko C, Wingo E, et al. A brief, trauma-informed intervention increases safety behavior and reduces HIV risk for drug-involved women who trade sex. *BMC Public Health.* 2017;18(1):75.

31. Abramsky T, Watts CH, Garcia-Moreno C, et al. What factors are associated with recent intimate partner violence? Findings from the WHO multi-country study on women's health and domestic violence. *BMC Public Health.* 2011;11(1):109.

32. Deering KN, Amin A, Shoveller J, et al. A systematic review of the correlates of violence against sex workers. *Am J Public Health.* 2014;104(5):e42-54.

33. Alexander P. Sex work and health: a question of safety in the workplace. *J Am Med Womens Assoc.* 1998;53(2):77-82.

34. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of General Psychiatry.* 1998;55(7):626-632.

35. Thoits PA. Stress and health: Major findings and policy implications. *Journal of Health and Social Behavior.* 2010;51(1_suppl):S41-S53.

36. Sinha R. Chronic stress, drug use, and vulnerability to addiction. *Annals of the new York Academy of Sciences.* 2008;1141(1):105-130.

37. UN General Assembly. Universal declaration of human rights. *UN General Assembly.* 1948.

38. Footer KH, Silberzahn BE, Tormohlen KN, Sherman SG. Policing practices as a structural determinant for HIV among sex workers: a systematic review of empirical findings. *Journal of the International AIDS Society.* 2016;19(4Suppl 3).

39. Shannon K, Strathdee SA, Goldenberg SM, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet.* 2015;385(9962):55-71.

40. Tenni B, Carpenter J, Thomson N. Arresting HIV: fostering partnerships between sex workers and police to reduce HIV risk and promote professionalization within policing institutions: a realist review. *PLoS One.* 2015;10(10):e0134900.

41. Potterat JJ, Brewer DD, Muth SQ, et al. Mortality in a long-term open cohort of prostitute women. *Am J Epidemiol.* 2004;159(8):778-785.

42. Brewer DD, Dudek JA, Potterat JJ, Muth SQ, Roberts JM, Woodhouse DE. Extent, Trends, and Perpetrators of Prostitution- Related Homicide in the United States. *Journal of Forensic Sciences.* 2006;51(5):1101-1108.

43. Stöckl H, Devries K, Rotstein A, et al. The global prevalence of intimate partner homicide: a systematic review. *The Lancet.* 2013;382(9895):859-865.

44. Ullman SE. Relationship to perpetrator, disclosure, social reactions, and PTSD symptoms in child sexual abuse survivors. *Journal of Child Sexual Abuse.* 2007;16(1):19-36.

45. Scott-Storey K. Cumulative abuse: do things add up? An evaluation of the conceptualization, operationalization, and methodological approaches in the study of the phenomenon of cumulative abuse. *Trauma, Violence, & Abuse.* 2011;12(3):135-150.

46. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry.* 1995;52(12):1048-1060.

47. Norris FH, Tracy M, Galea S. Looking for resilience: Understanding the longitudinal trajectories of responses to stress. *Social Science & Medicine.* 2009;68(12):2190-2198.

48. Ullman SE, Filipas HH, Townsend SM, Starzynski LL. Psychosocial correlates of PTSD symptom severity in sexual assault survivors. *Journal of Traumatic Stress.* 2007;20(5):821-831.

49. Paz-Bailey G, Noble M, Salo K, Tregear SJ. Prevalence of HIV among US female sex workers: systematic review and meta-analysis. *AIDS and Behavior.* 2016;20(10):2318-2331.

APPENDICES

PCL-5

READ: Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month. We know that these questions can be difficult to answer. I am now going to hand the tablet to you so that you can answer these questions in a private manner. [Hand the tablet to the participant].

DSM-5	In the past month, how much were you bothered by:		Not at all	A little bit	Moder-ately	Quite a bit	Extrem-ely
B1	PCL1	Repeated, disturbing, and unwanted memories of the stressful experience?	0	1	2	3	4
B2	PCL2	Repeated, disturbing dreams of the stressful experience?	0	1	2	3	4
B3	PCL3	Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?	0	1	2	3	4
B4	PCL4	Feeling very upset when something reminded you of the stressful experience?	0	1	2	3	4
B5	PCL5	Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?	0	1	2	3	4
C1	PCL6	Avoiding memories, thoughts, or feelings related to the stressful experience?	0	1	2	3	4
C2	PCL7	Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?	0	1	2	3	4
D1	PCL8	Trouble remembering important parts of the stressful experience?	0	1	2	3	4
D2	PCL9	Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?	0	1	2	3	4
D3	PCL10	Blaming yourself or someone else for the stressful experience or what happened after it?	0	1	2	3	4
D4	PCL11	Having strong negative feelings such as fear, horror, anger, guilt, or shame?	0	1	2	3	4
D5	PCL12	Loss of interest in activities that you used to enjoy?	0	1	2	3	4
D6	PCL13	Feeling distant or cut off from other people?	0	1	2	3	4
D7	PCL14	Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?	0	1	2	3	4
E1	PCL15	Irritable behavior, angry outbursts, or acting aggressively?	0	1	2	3	4
E2	PCL16	Taking too many risks or doing things that could cause you harm?	0	1	2	3	4
E3	PCL17	Being “superalert” or watchful or on guard?	0	1	2	3	4
E4	PCL18	Feeling jumpy or easily startled?	0	1	2	3	4
E5	PCL19	Having difficulty concentrating?	0	1	2	3	4
E6	PCL20	Trouble falling or staying asleep?	0	1	2	3	4

S1: Baseline characteristics of SAPPHIRE participants who completed and did not complete 3-month follow-up (N=230)

Variable	Completed 3 month n (%)	Did not complete 3 month n(%)	p-value	Total n (%)
Total	166 (100.0)	64 (100.0)		230 (100.0)
Age: mean (SD)	37 (9)	33 (8)	**0.009**	36 (9)
Race/ethnicity				
White (non-Hispanic)	111 (66.9)	43 (67.2)		154 (67.0)
Black (non-Hispanic)	39 (23.5)	13 (20.3)		52 (22.6)
Hispanic or Other	16 (9.6)	8 (12.5)	0.752	24 (10.4)
Relationship status binary				
In a relationship or married	58 (34.9)	17 (26.6)		75 (32.6)
Single	108 (65.1)	46 (71.9)	0.252	154 (67.0)
Education level				
High school/GED or greater	79 (47.6)	33 (51.6)		112 (48.7)
Less than grade 12	87 (52.4)	31 (48.4)	0.589	118 (51.3)
Homeless in the past 3 months				
No	75 (45.2)	12 (18.8)		87 (37.8)
Yes	91 (54.8)	52 (81.3)	**<0.001**	143 (62.2)
Arrested in the past 12 months				
No	90 (54.2)	31 (48.4)		121 (52.6)
Yes	75 (45.2)	33 (51.6)	0.406	108 (47.0)
Any physical or sexual abuse before age 18				
No	74 (46.3)	29 (46.0)		103 (44.8)
Yes	86 (53.8)	34 (54.0)	0.977	120 (52.2)
Length in street-based sex work				
6+ years	90 (54.2)	30 (46.9)		120 (52.2)
<=5 year	76 (45.8)	34 (53.1)	0.318	110 (47.8)
Any heroin past 12 months				
No	22 (13.3)	4 (6.3)		26 (11.3)
Yes	144 (86.7)	60 (93.8)	0.133	204 (88.7)
Any cocaine or crack past 12 months				
No	21 (12.7)	5 (7.8)		26 (11.3)
Yes	145 (87.3)	59 (92.2)	0.299	204 (88.7)
PTSD				
PTSD severity: mean (SD)	40 (23)	37 (20)	0.379	39 (22)
No PTSD symptoms	63 (38.0)	26 (40.6)		89 (38.7)
PTSD symptoms 33-80	103 (62.0)	38 (59.4)	0.709	141 (61.3)

S2: Baseline characteristics of SAPPHIRE participants who completed and did not complete 6-month follow-up (N=230)

Variable	Completed 6 month n (%)	Did not complete 6 month n (%)	p-value	Total n (%)
Total	156 (100.0)	74 (100.0)		230 (100.0)
Age: mean (SD)	37 (9)	33 (8)	**0.009**	36 (9)
Race/ethnicity				
White (non-Hispanic)	106 (67.9)	48 (64.9)		154 (67.0)
Black (non-Hispanic)	32 (20.5)	20 (27.0)		52 (22.6)
Hispanic or Other	18 (11.5)	6 (8.1)	0.454	24 (10.4)
Relationship status binary				
In a relationship or married	16 (21.9)	59 (37.8)		
Single	57 (78.1)	97 (62.2)	**0.017**	154 (67.3)
Education level				
High school/GED or greater	75 (48.1)	37 (50.0)		112 (48.7)
Less than grade 12	81 (51.9)	37 (50.0)	0.785	118 (51.3)
Homeless in the past 3 months				
No	69 (44.2)	18 (24.3)		87 (37.8)
Yes	87 (55.8)	56 (75.7)	**0.004**	143 (62.2)
Arrested in the past 12 months				
No	33 (44.6)	88 (56.8)		121 (52.8)
Yes	41 (55.4)	67 (43.2)	0.084	108 (47.2)
Any physical or sexual abuse before age 18				
No	35 (48.0)	68 (45.3)		103 (46.2)
Yes	38 (52.1)	82 (54.7)	0.714	120 (53.8)
Length in street-based sex work				
6+ years	92 (59.0)	28 (37.8)		120 (52.2)
<=5 year	64 (41.0)	46 (62.2)	**0.003**	110 (47.8)
Any heroin past 12 months				
No	19 (12.2)	7 (9.5)		26 (11.3)
Yes	137 (87.8)	67 (90.5)	0.543	204 (88.7)
Any cocaine or crack past 12 months				
No	17 (10.9)	9 (12.2)		26 (11.3)
Yes	139 (89.1)	65 (87.8)	0.777	204 (88.7)
PTSD				
PTSD severity: mean (SD)	40 (22)	37 (20)	0.379	39 (22)
No PTSD symptoms	58 (37.2)	31 (41.9)		89 (38.7)
PTSD symptoms 33-80	98 (62.8)	43 (58.1)	0.493	141 (61.3)

CURRICULUM VITAE

JU NYEONG PARK

PERSONAL DATA

Business: Department of Health Behavior and Society
Bloomberg School of Public Health
The Johns Hopkins University
624 N Broadway, Hampton House, Room 163
Baltimore, MD 21205
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Fax: (410) 502-4333
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Home: 2122 E Pratt St
Baltimore, MD 21231
Cell: (202) 386-2834

EDUCATION

Ph.D. 2018 The Johns Hopkins University
Bloomberg School of Public Health, Department of Epidemiology
Thesis: *The epidemiology of violence and posttraumatic stress disorder among street-based female sex workers in Baltimore, Maryland.*
Advisor: Susan Sherman, PhD MPH
Co-Advisor: Noya Galai, PhD

M.H.S. 2013 The Johns Hopkins University
Bloomberg School of Public Health, Department of Epidemiology
Thesis: *HIV prevalence and HIV testing among men who have sex with men in Cameroon.*
Thesis Advisor: Stefan Baral, MD MPH MBA
Academic Advisor: Shruti Mehta, PhD MPH

B. S. 2009 University of Sydney, Neuroscience & Physiology
Cornell University, International Study, Spring 2008

PROFESSIONAL EXPERIENCE

2018- Assistant Scientist, Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

2017-2018 Study Director, Fentanyl Overdose Reduction Checking Analysis Study (FORECAST), Bloomberg American Health Initiative, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

2015-2018 Data Manager and Analyst, Sex-workers And Police Promoting Health In Risky Environments (SAPPHIRE) study, Department of Health, Behavior

	and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2016-2017	Study Coordinator, Baltimore Syringe Exchange Program study, Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2015-2016	Quantitative Research Consultant, Needs-Assessment for Responding to Public Health Emergencies, World Health Organization, Geneva, Switzerland
2013-2016	Data Manager, Field Coordinator and HIV Counselor, the Centers for Disease Control and Prevention (CDC) National HIV Behavioral Surveillance study (Baltimore site), Maryland Department of Health and Mental Hygiene and Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2013-2014	Data Manager for the Enhancing Provider-Initiated HIV Testing in Sydney project, Kirby Institute, University of New South Wales, Sydney, Australia
2012-2013	Research Assistant, the AIDS Linked to the Intravenous Experience (ALIVE) Study, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2012	HIV/AIDS Research Intern in Yaoundé, Cameroon, USAID HIV Epidemiology study. Center for Global Health, Johns Hopkins University, Baltimore, Maryland
2011-2012	Research Assistant, Center for Public Health and Human Rights, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2010-2011	Research Assistant on the Hepatitis C Incidence and Transmission study, Kirby Institute, University of New South Wales, Sydney, Australia
2008	Research Assistant, Chronobiology and Sleep program, Brain and Mind Centre, University of Sydney

PROFESSIONAL ACTIVITIES

Society membership

2017-	Society for Epidemiologic Research
2013-	International AIDS Society
2011	Australian Society for HIV Medicine (ASHM)

Participation on Advisory Panels

2013-2014	Community Advisory Board, Center For AIDS Research, Johns Hopkins University
2014	Baltimore City Overdose Response Planning Committee, Behavioral Health Systems Baltimore

Academic leadership

2016-	Department of Epidemiology Representative (joint), Doctoral Student Council, Student Assembly, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2015-2016	President (joint), Epidemiology Student Organization, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

2014	Evaluator, Baltimore HIV/AIDS Scholars Program, Center For AIDS Research, Johns Hopkins University
2013-2014	Social Chair, Epidemiology Student Organization, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2011	Website Committee, Kirby Institute, University of New South Wales, Sydney, Australia

Community service

2017	Volunteer Epidemiologist, Surveillance and Outbreak Response Team (SORT), Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2016-2017	Hiring Committee, Baltimore Harm Reduction Coalition, Baltimore, Maryland
2014-2015	Program Coordinator, Overdose Education and Naloxone Distribution program, Baltimore Harm Reduction Coalition, Baltimore, Maryland
2011-2013	Events Chair, Baltimore Harm Reduction Coalition, Baltimore, Maryland
2012	Community Advisory Board, Connect 2 Protect, Baltimore, Maryland
2008-2009	Drug and Alcohol Case Manager, Drug-ARM, Sydney, Australia
2007	Fundraising volunteer for University of Sydney Oxfam Society, Sydney, Australia

Certifications

2013	Maryland HIV Counseling & Testing Skills Level I, University of Maryland
2013	Certificate in Public Health, National Board of Public Health Examiners, USA
2013	Overdose Prevention & Response Training, Baltimore City Health Department
2010	HIV/Hepatitis Counseling, Albion Centre, Sydney, Australia
2010	Phlebotomy training, Pathology Foundation, Sydney, Australia
2009	Workplace First Aid, Australian Red Cross, Sydney, Australia

Peer Review Activities

2018-	AIDS & Behavior
2018-	Drug and Alcohol Dependence
2017-	Journal of the International AIDS Society
2017-	AIDS Care
2017-	Harm Reduction Journal
2015-	Sexually Transmitted Infections

HONORS AND AWARDS

2016	Charlotte Silverman Fund: $4000, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2015	Doctoral Tuition Scholarship: $140,000, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2014	10th National Harm Reduction Conference Scholarship, New York
2013	International AIDS Society Conference Scholarship, Geneva, Switzerland

2013 Center for Global Health Conference Travel Grant, Johns Hopkins University, Baltimore Maryland
2013 Anna Huffstutler Stiles Scholarship: $1,920, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2013 Community Service Award, Johns Hopkins Student Outreach Resource Center, Baltimore, Maryland
2012 Graduate Student Conference Grant, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2012 Established Field Placement Grant: $5,500, Center for Global Health, Johns Hopkins University, Baltimore Maryland
2012 Master's Tuition Scholarship: $33,300, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
2009 Academic Honors, University of Sydney, Sydney, Australia
2009 Science Honors Scholarship, Faculty of Medicine, University of Sydney, Sydney, Australia
2009 Honors Summer Research Scholarship: $500, Faculty of Medicine, University of Sydney, Sydney, Australia
2007 International Exchange Scholarship, University of Sydney, Sydney, Australia

PUBLICATIONS

Journal articles

1. **Park JN**, White B, Bates A, Enriquez J, Liao L, Maher L. Motivators and barriers influencing willingness to participate in candidate HCV vaccine trials: perspectives of people who inject drugs. Drug Alcohol Depend. 2012;123(1-3):35-40.
2. **Park JN**, Papworth E, Kassegne S, Moukam L, Billong SC, Macauley I, Yomb YR, Nkoume N, Mondoleba V, Eloundou J, LeBreton M, Tamoufe U, Grosso A, Baral S. HIV prevalence and factors associated with HIV infection among men who have sex with men in Cameroon. J Int AIDS Soc. 2013;16 Suppl 3:18752.
3. **Park JN**, Papworth E, Billong SC, Elat JB, Kassegne S, Grosso A, Moukam L, Macauley L, Yomb YR, Mondoleba V, Eloundou J, LeBreton M, Ketende SC, Baral S. Correlates of prior HIV testing among men who have sex with men in Cameroon: a cross-sectional analysis. BMC Public Health. 2014;14:1220.
4. Lewis DA, **Park JN**, Vail L, Sine M, Welsh C, Sherman SG. Evaluation of the Overdose Education and Naloxone Distribution Program of the Baltimore Student Harm Reduction Coalition. Am J Public Health. 2016;106(7):1243-6.
5. Maragh-Bass AC, Powell C, **Park JN**, Flynn C, German D. Sociodemographic and access-related correlates of health-care utilization among African American injection drug users: The BESURE study. J Ethn Subst Abuse. 2016:1-19.
6. Fallon SA, **Park JN**, Ogbue CP, Flynn C, German D. Awareness and Acceptability of Pre-exposure HIV Prophylaxis Among Men Who have Sex with Men in Baltimore. AIDS Behav. 2016.
7. German D, Brady K, Kuo I, Opoku J, Flynn C, Patrick R, **Park JN**, Adams J, Carroll M, Simmons R, Smith CR, Davis W. and the Mid-Atlantic CFAR Consortium. Characteristics of Black men who have sex with men in Baltimore, Philadelphia, and Washington, D.C.: Geographic diversity in socio-demographics and HIV transmission risk. J Acquir Immune Defic Syndr. 2017; 75 (Suppl 3): S296-S308.

8. Sherman, SG, Hast, M, **Park, JN,** Decker, MR., Flynn C., German D. Correlates of exchange sex among a population-based sample of low-income women who have heterosexual sex in Baltimore. AIDS Care. 1-9.
9. Hunter K, **Park JN**, Allen ST, Chaulk P, Frost T, Weir BW, Sherman SG. Safe and unsafe spaces: Non-fatal overdose, arrest, and receptive syringe sharing among public and semi-public injectors in Baltimore City. International Journal of Drug Policy. 2018: 57: 25-31.
10. **Park JN**, Weir B, Allen, ST, Chaulk P, Sherman SG. Fentanyl-contaminated drugs and non-fatal overdose among people who inject drugs in Baltimore, MD. Harm Reduction Journal. 2018. 15 (1): 1-8.
11. Allen ST, Footer KHA, Galai N, **Park JN**, Silberzahn B, Sherman SG. Implementing Targeted Sampling: Lessons Learned from Recruiting Female Sex Workers in Baltimore, MD. Accepted in J Urban Health.
12. Footer KHA, **Park JN**, Allen ST, Decker MR, Silberzahn BE, Huettner S, Galai N, Sherman SG. Police related correlates of client violence among female sex workers in Baltimore City, Maryland, USA. Accepted in American Journal of Public Health.

Manuscripts under review / revise-resubmit

1. **Park JN**, Nail, J, Lim, S, Zelaya C, Sherman S. Prevalence and correlates of post-traumatic stress disorder and depression symptoms among female exotic dancers in Baltimore.
2. **Park JN**, Linton SL, Sherman, SG, German D. Police violence among people who inject drugs in Baltimore, Maryland.
3. Sherman SGS, Schneider KE, Park JN, Allen ST, Hun, D., Chaulk P, Weir BW. PrEP eligibility and interest among people who inject drugs in Baltimore, Maryland.
4. Rouhani S, Gudlavalleti R, Atzmon D, **Park JN**, Olsen SP, Sherman SG. Police attitudes towards pre-booking diversion in Baltimore City: the role of experience in taking a public health approach to law enforcement.
5. Coupland H, White B, Bates A, **Park JN**, Iversen J, Maher L. Engaging people who inject drugs in hepatitis C virus prevention and treatment through outreach.
6. Tomko C, **Park, JN**, Allen ST, Glick J, Galai N, Decker MR, Footer KF, Sherman SG. Awareness and Interest in HIV Pre-exposure Prophylaxis (PrEP) Among Street-based Female Sex Workers: Results from a US Context.

Curriculum Vitae

JU NYEONG PARK
Part II

TEACHING

Internship supervisor

2017	Anyu Xue, Bachelor's degree candidate
2015	Catie Edwards, Bachelor's degree candidate

Course Instruction

2016	Section Instructor, Fundamentals of Epidemiology, Department of Epidemiology

Invited Lectures

2018	"Non-Probability Sampling." Health Survey Research Methods, Johns Hopkins Bloomberg School of Public Health Summer Institute
2018	"Quality Assurance and Quality Control." Health Survey Research Methods, Johns Hopkins Bloomberg School of Public Health Summer Institute
2016-2017	"Quality Assurance and Quality Control." Health Survey Research Methods, Department of Epidemiology
2016	"Sex, drugs and HIV." Fundamentals of Epidemiology, Department of Epidemiology
2017	"Sex workers in Baltimore: An Untold Story." Generation Tomorrow, Center for AIDS Research

Teaching assistant

2012	Principles of Epidemiology, Department of Epidemiology
2012	Epidemiology and Public Impact of HIV/AIDS, Department of Epidemiology
2012	Advanced Topics on Control and Prevention of HIV/AIDS, Department of Epidemiology
2012	Epidemiology and Natural History of Human Viral Infections, Department of Epidemiology

Journal club

2017	Co-presentor: "Social and structural determinants of health: The HIV risk environment." Infectious Disease Epidemiology Journal Club, Department of Epidemiology
2013	Co-presentor: "Evidence for Opioid Substitution Therapy in reducing HIV transmission." Infectious Disease Epidemiology Journal Club, Department of Epidemiology

GRANT PARTICIPATION

Harm Reduction Outreach Evaluation
Maryland Department of Health 01/01/2018-10/31/2019 (PI: Sherman)
This study will evaluate the expansion of outreach-based harm reduction education and services among street-based opioid users in two counties of Maryland.
Role: Co-Investigator

The HIV risk environment of high-risk women: Interaction with public safety
NIH/NIDA; R01DA038499 02/01/15-11/30/18 (PI: Sherman)
The study examines the role of police in the HIV risk environment of female sex workers (FSWs) in Baltimore Maryland.
Responsibilities: Protocol development; survey development; data management; data analysis; manuscript preparation; supporting IRB submissions and reporting, grant reporting.

The Fentanyl Overdose Reduction Checking Analysis Study
Bloomberg Philanthropies 02/01/17-12/15/17 (PI: Sherman)
This multi-site study examined the feasibility and acceptability of fentanyl checking for public health applications, and included laboratory validation of fentanyl checking tools, and qualitative and quantitative data collection among people who use drugs and service providers.
Responsibilities: Collaboration on grant proposal; protocol and survey development; oversight of human subject research and JHU IRB approval; coordination with and training of team members from Boston, Providence and Baltimore, and implementing laboratory partners; data management; quantitative and qualitative analysis; manuscript preparation; data presentations to local, state and federal government agencies and at several scientific meetings; grant reporting.

Evaluation of Needle Exchange Distribution Policy
AmFAR Foundation 02/1/16-01/31/17 (PI: Sherman)
The study evaluated the impact of a policy change from 1:1 to needs-based syringe distribution on needle exchange services and client profiles as well as risk behaviors.
Responsibilities: Project management; survey development; data management; data analysis; evaluation report; manuscript preparation; grant reporting.

Community Project grant
Open Society Institute - Baltimore 2012-2017 (PI: Kirschner/Sine)
Salary and operational support to the Baltimore Harm Reduction Coalition for social justice advocacy, community service and education.
Role: Co-investigator

PRESENTATIONS

Scientific Meetings

1. **Park, J.N.**, Bass, J., Decker, M.R., Sherman, S.G. Cumulative Violence Exposure, Substance Use and PTSD among street-based female sex workers in Baltimore,

Maryland. Oral session: International Society for Traumatic Stress Studies; 2018 Nov 8; Washington D.C.

2. **Park, J.N.**, McKenzie, M., Sherman, S.G., Green, T.C. Detecting Fentanyl in Street Drugs Using Fentanyl Testing Strips and Portable Machines: Results of a Multi-Site Validation Study. Oral session: the 12th National Harm Reduction Conference; 2018 Oct 18-21; New Orleans, LA.
3. **Park, J.N.**, Morales, K., McKenzie, M., Green, T.C., Marshall, B., Sherman, S.G. Willingness of People who use Drugs to Check their Drugs for Fentanyl: A Multisite Study. Poster session: The College of Problems of Drug Dependence (CPDD); 2018 Jun 9-14; San Diego, California.
4. **Park, J.N.**, Morales, K., Christensen, T., Glick, J., McKenzie, M., Green, T.C., Sherman, S.G. Implementation considerations in distributing fentanyl test strips to people at risk of opioid overdose. Poster session: Maryland Harm Reduction Summit; 2018 Jun 28; Baltimore, Maryland.
5. **Park, J.N.**, Allen, S.T., Decker, M.R., Footer, K., Galai, N., Huettner, S., Silberzahn, B., Morris, M., Sherman S.G. Longitudinal Correlates of Non-Fatal Overdose Among Street-Based Female Sex Workers in Baltimore City. Poster session: Society for Epidemiologic Research Meeting; 2018 Jun 19-22; Baltimore, Maryland.
6. **Park, J.N.**, Raifman, J., Footer, K., Decker, M., Galai, N., Sherman, S.G. PrEP awareness, interest and engagement among Baltimore female sex workers. Poster session: International AIDS Society Conference on HIV Science; 2017 Jun 23-Jul 26; Paris, France.
7. Allen S., **Park J.N.**, Weir B.W., Holtgrave D., Sherman S.G. Effects of Syringe Distribution Policy Change at A Syringe Services Program in Baltimore, MD: A Forecast Analysis. Oral session: International AIDS Society Conference on HIV Science; 2017 Jun 23-Jul 26; Paris, France.
8. Sherman S.G., **Park J.N.**, Silberzahn B., Huettner S., Decker M.R., Galai N., Footer K.H. Police encounters: A structural driver of HIV risk behaviors among street-based, cis-female sex workers in Baltimore, Maryland, USA. Poster session: International AIDS Society Conference on HIV Science; 2017 Jun 23-Jul 26; Paris, France.
9. Sherman S.G., Schneider K.E., **Park J.N.**, Allen S.T., Weir B.W. PrEP interest and eligibility among people who inject drugs in Baltimore, Maryland, USA: A missed opportunity for prevention. Poster session: International AIDS Society Conference on HIV Science; 2017 Jun 23-Jul 26; Paris, France.
10. Allen S., **Park J.N.**, Weir B.W., Holtgrave D., Sherman S.G. Understanding syringe distribution policy change in Baltimore, MD: Effects on syringe distribution and HIV incidence among people who inject drugs. Poster session: The College on Problems of Drug Dependence; 2017 June 17–22: Montreal, Canada.
11. German, D., Shearer, K., **Park, J.N.**, Flynn, C., Latkin, C., Laeyendecker, O., Quinn, T., Clarke, W. Factors Associated with Misreporting HIV Status among MSM from Baltimore. Poster session: Conference on Retroviruses and Opportunistic Infections (CROI); 2016 Feb 22-25; Boston, Massachusetts.
12. German, D., Brady, K., Kuo, I., Opoku, J., Flynn, C., Adams, J., Patrick, R., **Park, J.N.** and the Mid-Atlantic CFAR Consortium. Characteristics of African-American men who have sex with men in Baltimore, Philadelphia, and Washington, DC Oral session: National HIV Prevention Conference; 2015 Dec 6-9; Atlanta, Georgia.
13. **Park, J.N.,** Vail, L., Kirshner, J., Niculescu, A., Lewis D., Welsh, C., Sherman, S. Overdose Education and Naloxone Distribution for potential bystanders of opioid

overdose: A BSHRC pilot project in central Maryland. Oral session: 10th National Harm Reduction Conference; 2014 Oct 23-26; Baltimore, Maryland.

14. German, D., **Park, J.N.,** Powell, C., Flynn, C. Trends in HIV Prevalence, Injection Behaviors, and Syringe Exchange Utilization Among Baltimore Injection Drug Users. Oral session: 10th National Harm Reduction Conference; 2014 Oct 23-26; Baltimore, Maryland.
15. **Park, J.N.,** Ogbue, C., Spencer, L., Flynn, C., German, D. Socio-demographic correlates of accessing needle exchange programs among people who inject drugs in Baltimore: A comparison of 2009 and 2012 data. Poster session: 10th National Harm Reduction Conference; 2014 Oct 23-26; Baltimore, Maryland.
16. **Park, J.N.,** Ogbue, C., Spencer, L., Flynn, C., German, D. Prevalence of non-injection drug use, alcohol use, and drug and alcohol treatment utilization in Baltimore city: Comparison of 2010 and 2013 BESURE data. Poster session: 10th National Harm Reduction Conference; 2014 Oct 23-26; Baltimore, Maryland.
17. Ogbue, C., Robinson, A., **Park, J.N.**, Flynn, C., German, D. Insurance status and related factors among injection drug users in Baltimore: Implications for harm reduction and healthcare programs. Poster session: 10th National Harm Reduction Conference; 2014 Oct 23-26; Baltimore, Maryland.
18. **Park, J.N.,** Murray K., Murray, D., Denoe,M., McGrath, C., Post, J., Maher, L. The impact of a brief educational intervention in reducing barriers to provider-initiated HIV testing among healthcare providers in Sydney, Australia. Poster session: 20th International AIDS Conference; 2013 Jul 20-25; Melbourne, Australia.
19. **Park, J.N.,** Papworth, E., Moukam, L., Macauley, I.B., Yomb, Y.R., Nkoume, N., Eloundou, J., Lebreton, M., Ketende, S., Grosso, A., Lee, J.A., Baral, S. Optimizing multicomponent interventions for men who have sex with men (MSM) in Cameroon: Factors associated with HIV testing. Poster session: 7th International AIDS Society Conference on HIV Pathogenesis, Treatment and Prevention; 2013 Jun 30-Jul 3; Kuala Lumpur, Malaysia.
20. Kirschner, J., Pappas, A., **Park, J.N.** Building and Sustaining a Multidisciplinary Student Harm Reduction Coalition. Oral session: 9th National Harm Reduction Conference; 2012 Nov 15-18; Portland, Oregon.
21. White, B., Dore, G.J., Bates, A., Enriquez, J., Chow, S., **Park, J.N.,** Lloyd, A., Rawlinson, W., Maher, L. High but declining HCV incidence in people who inject drugs in Sydney, Australia. Oral session: 8th Australasian Viral Hepatitis Conference; 2012 Sep 10-12; Auckland, New Zealand.
22. Bates, A., Enriquez, J., Chow, S., **Park, J.N.**, Maher, L. Engaging and following up people with acute hepatitis C infection in an outreach setting. Poster session: 8th Australasian Viral Hepatitis Conference; 2012 Sep 10-12; Auckland, New Zealand.
23. White, B., Bates, A., Enriquez, J., **Park, J.N.**, Maher, L. Impact of recruitment strategy on retention of people who inject drugs in a longitudinal study in Sydney, Australia Poster session: 22nd International Harm Reduction Association Conference; 2011 Apr 3-7; Beirut, Lebanon.
24. White, B., Bates, A., Donald, A., Enriquez, J., Liao, L., **Park, J.N.**, Pham, S., Maher, L. Acceptability and willingness to participate in vaccine trials among young people who inject drugs in Sydney Australia (on behalf of the UNSW HCV Vaccine Initiative). Poster session: 18th International AIDS Conference; 2010 Jul 18-23; Vienna, Austria.
25. **Park, J.N.**, Whitwell, B.G., Hermens, D.F., Scott, E.M., Hickie, I.B., Rogers, N.L. Instability of sleep-wake patterns in young patients with a mood disorder. Poster session:

SLEEP. 24th Annual Meeting of the Associated Professional Sleep Societies; 2010 Jun 5-9; San Antonio, Texas.

Invited presentations

1. **Park, J.N.**, Green, T., Sherman, S.G. The FORECAST Study: Initial Results. Maryland Department of Health, Drug User Working Group.
2. Green, T., **Park J.N.,** Sherman, S.G. The FORECAST Study: Initial Results. Science & Technology Directorate's Opioid Working Group. Department of Homeland Security.
3. **Park, J.N.** Let's talk about Fentanyl. Bmore Power Hackathon. Johns Hopkins Communication Programs. January 31, 2018. Baltimore, Maryland.
4. **Park, J.N.,** Allen S., Weir, B., Sherman, S. Assessment of syringe coverage among Baltimore Syringe Exchange Program clients: Preliminary findings. Baltimore City Health Department. July 13, 2016. Baltimore, Maryland.
5. **Park, J.N.,** Pappas, A. Baltimore Student Harm Reduction: Year in Review. 2013. Baltimore Student Harm Reduction Members, Advisory Board and Community Partners. Baltimore, Maryland.
6. **Park, J.N.,** Tanz, L. Rhodes, C., Rajan, R. Alcohol awareness and safety. Johns Hopkins University Kappa Kappa Gamma Sorority, 2013. Baltimore, MD
7. **Park, J.N.,** Waldrop, G. Public health and outbreak investigations. Baltimore Polytechnic Institute, March 2012. Baltimore, MD

PROFESSIONAL DEVELOPMENT

Technical skills

Data management and statistical analysis of large datasets in Stata
Stata, SAS, SPSS
Multivariate regression modeling, multilevel modeling
Longitudinal Data Analysis (e.g. survival analysis, mixed-effects, time-series analysis, Generalized Estimating Equations)
Confirmatory Factor Analysis
Latent Class Analysis
Structural Equation Modeling
Weighted data (e.g. Survey Weights, Time Location Sampling, Respondent Driven Sampling)
Multiple imputation
Focus groups and key informant interviews
Audio Computer-Assisted Self-Interview (ACASI); Computer-Assisted Self-Interview (CASI); Computer-Assisted Personal Interview (CAPI)
Questionnaire Development System™
Redcap™
Survey Monkey™
ArcGIS™
RDSAT™
MPLUS™
Google forms™
Social media
Microsoft Office™
EndNote™, Refworks™

FOREIGN LANGUAGE SKILLS

English, native speaker; Korean, native speaker.

ADDITIONAL INFORMATION

Personal statement of research and research objectives

My research over the past eight years has focused on the health of marginalized populations in the U.S., Australia and Cameroon, specifically HIV, HCV and opioid overdose among people who inject drugs, men who have sex work men and female sex workers. I have expertise in epidemiologic methods, confirmatory factor analysis, longitudinal data analysis, and program evaluation. My research has appeared in numerous journals including the American Journal of Public Health, Drug and Alcohol Dependence, the International Journal of Drug Policy, and JAIDS. I currently conduct U.S.-based research that aims to alleviate burdens associated with HIV, trauma, and the fentanyl epidemic. I will be continuing this research as an Assistant Scientist in the Department of Health, Behavior, and Society at the Johns Hopkins Bloomberg School of Public Health.

Keywords: HIV, drug use, opioid overdose, gender-based violence, mental health