

Mapping Workplace Neighborhood Mobility Among Sex Workers in an Urban Canadian Setting: Results of a Community-Based Spatial Epidemiological Study From 2010-2016

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Abstract

Mobility among sex workers has been linked not only to improved economic and social opportunities, but also to concerns regarding displacement, criminalization, and violence. In 2014, new “end-demand” legislation criminalized new aspects of sex work in Canada (e.g., third-party advertising, purchasing) while leaving the sale of sex legal. Utilizing data from a longitudinal community-based cohort of women sex workers in Metro Vancouver (An Evaluation of Sex Workers Health Access [AESHA], 2010-2016), we used kernel density mapping to understand and identify

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geographic patterns of workplace neighborhood mobility (i.e., changing the primary neighborhood in which one worked in the last 6 months); multivariable logistic regression using generalized estimating equations was also used to model contextual (policing, violence, and safety) and individual correlates of workplace mobility among sex workers over the 6-year period, including potential changes in mobility patterns pre- and post-end-demand criminalization. A total of 543 sex workers were included in analyses, contributing 2,199 observations. A total of 402 (74.0%) experienced workplace neighborhood mobility during the study period. Neighborhood mobility was negatively correlated with age (adjusted odds ratio [AOR] = 0.98/year older, 95% confidence interval [CI] = [0.97, 0.99]) and positively correlated with homelessness (AOR = 1.43, 95% CI = [1.12, 1.82]), identifying as a gender/sexual minority (AOR = 1.31, 95% CI = [1.04, 1.70]), and servicing clients primarily outdoors (vs. informal indoor or in-call venues; AOR = 1.48, 95% CI = [1.21, 1.81]); police harassment (AOR = 1.19, 95% CI = [0.96, 1.48], $p = .11$) and changing one's neighborhood of work due to safety concerns (AOR = 1.37, 95% CI = [0.94, 2.00], $p = .09$) were both marginally correlated. Steps to promote safer working conditions for marginalized women in urban environments remain urgently needed, including shifts away from criminalized enforcement toward community-led initiatives and promoting access to safer indoor workspaces.

Keywords

sex work, mobility, displacement, spatial epidemiology, work environment

Introduction

Mobility within a population is often driven by a desire for improved employment and social opportunities and often leads to changes in health and well-being in the new place of residence (Goldenberg, Chettiar, et al., 2014; Goldenberg, Strathdee, Perez-Rosales, & Sued, 2012; Goldenberg, Strathdee, Gallardo, & Patterson, 2010; Goldenberg, Silverman, Engstrom, Bojorquez-Chapela, & Strathdee, 2014; Reed, Gupta, Biradavolu, & Blankenship, 2012). However, despite the potential availability of better economic opportunities in their new location, mobile populations also report, in certain contexts, experiences of increased isolation, reduced access to social networks and social support, barriers to health access, precarious and unsafe working conditions, enhanced violence, and increased stigma and discrimination (S. Y. Choi, 2011; Goldenberg et al., 2010; Parrado & Flippen, 2010; Platt et al., 2006; Reed et al., 2012; Sou et al., 2017).

Women who engage in mobility and migration are overrepresented in precarious and informal work, including sex work (Platt et al., 2012). Existing literature indicates that mobility among sex workers may be driven by “pull” factors such as economic needs, social networks, and a search for improved working conditions and new experiences, as well as “push” factors such as displacement related to criminalization and law enforcement and gender-based violence (Goldenberg, Chettiar, et al., 2014; Jie et al., 2012; Lippman et al., 2007; Saggurti et al., 2012; Yi et al., 2010). Research on the relationship between mobility and sex workers’ health and safety in urban environments within the global north remains limited, with most work focused on international or internal migration and impacts on sex workers’ working conditions, including violence, in low- and mid-income countries and links with infectious diseases. Less attention has been given to safety or interactions with law enforcement, yet we know these are crucial concerns for marginalized women, especially in global north contexts (Ferguson & Morris, 2007; Lytleton & Amarapibal, 2002; Reed et al., 2012; Richter et al., 2014; Rushing, Watts, & Rushing, 2005; Verma, Saggurti, Singh, & Swain, 2010).

Previous research has demonstrated alarmingly high rates of violence, poor working conditions, criminalization, and social inequities faced by sex workers globally (Decker et al., 2015; Shannon et al., 2015), including physical and sexual violence, barriers to consistent condom use and health access, and frequent stigma and discrimination (Goldenberg, Chettiar, et al., 2014; Ramesh, Ganju, Mahapatra, Mishra, & Saggurti, 2012; Saggurti et al., 2012). Although several studies globally have suggested that sex workers who are highly mobile experience more violence and discrimination (Saggurti et al., 2008, 2012), little is known about the extent to which geographic mobility patterns within urban settings relate to experiences of criminalization or displacement by law enforcement. For example, previous research conducted in India found that women engaging in sex work–related mobility to attend religious festivals faced twice the rate of violence as those who did not engage in such mobility (Saggurti et al., 2012). A second study, also conducted in India, highlighted the fact that a greater proportion of those engaging in sex work–related mobility outside their place of residence experienced violence and abuse compared with those who were not mobile (Ramesh et al., 2012; Richter et al., 2014). Within higher income countries, however, there remains a gap in our understanding of how mobility patterns shape the well-being and safety of sex workers.

Prior research from Metro Vancouver, Canada, has found that international and internal migration among sex workers are linked to improved opportunities, as well as health and social inequities. Short-term internal migration has been linked to younger age, higher income, and barriers to health access (Goldenberg,

Chettiar, et al., 2014). International migration among sex workers has also been linked to increases in work-related violence and condom refusal by intimate partners, as well as barriers to health access, racialization, and workplace inspections by the police and municipal or immigration authorities (Anderson et al., 2015; Goldenberg, Chettiar, et al., 2014).

Within research pertaining to sex workers' health and safety, only a limited number of studies have used spatial analysis, despite its important potential to inform service planning and policy. Spatial research from Vancouver has previously shown that sex workers may avoid areas in which health and social services are concentrated due to concerns regarding policing, which may undermine access to essential health and violence supports (Shannon et al., 2008). A recent spatial study found that heightened displacement due to policing was independently correlated with HIV treatment interruptions (Goldenberg et al., 2017), suggesting that the social geography of sex work criminalization may undermine access to essential medicines, such as HIV treatment. Despite the demonstrated value of spatial analysis for understanding migration patterns and health access patterns among other populations (Collinson, 2010; Wolffers & Fernandez, 1995), particularly within urban environments, spatial analysis has been infrequently used to understand sex workers' migration and mobility patterns and social outcomes.

In Canada, sex work has been historically criminalized through provisions targeting various aspects of the sale of sex; following the striking down of these laws in 2013 as unconstitutional, in 2014, the Canadian government introduced the Protection of Communities and Exploited Persons Act (PCEPA; Chu & Canadian HIV/AIDS Legal Network, 2014; Perrin, 2014), which criminalized the purchase of sex and third-party activities, while leaving the sale of sex legal. This new legislation—known internationally as “end-demand criminalization”—was introduced despite a dearth of evidence of beneficial impacts for sex workers. Concerns have been raised that as a result of shifting surveillance and law enforcement efforts, sex workers may face reduced access to safer in-call spaces (e.g., massage parlors, micro-brothels) and potential displacement to more unsafe and less populated places such as the street and informal indoor venues (e.g., hotels, bars), which may increase exposure to physical and sexual violence (Goldenberg, Chettiar, et al., 2014). For example, hypothesized health and safety impacts of this legislation include its potential to increase displacement and poor working conditions by pushing sex workers and clients to conduct transactions in more hidden, isolated, and unsafe workspaces and perpetuate adversarial interactions with law enforcement, all of which have been linked to enhanced violence and barriers to health and social services for sex workers (Krüsi et al., 2014; Network of Sex Work Projects [NSWP], 2018). These concerns

are supported by recent reports from Nordic countries, where similar laws were implemented but failed to improve safety. In fact, they have been shown to result in unintended negative consequences, including those stemming from avoidance of outdoor public places in favor of more hidden places and lost income (Chu & Glass, 2013).

Our study was informed by the dearth of longitudinal evidence regarding the social geography of neighborhood mobility among sex workers in higher income settings, as well as serious concerns regarding the potential for shifting criminalization enforcement as a result of “end-demand” legislation to impact urban displacement patterns, violence, and working conditions among sex workers. Our objective was to examine the spatial patterning and longitudinal correlates of workplace neighborhood mobility (i.e., changing the neighborhood in which one’s primary work environment is located). In addition, we wanted to assess potential changes in locations where sex workers solicit and service clients, pre- and postimplementation of end-demand legislation, among a community-based cohort of women sex workers in Metro Vancouver, Canada, over a 6-year period.

Method

The data used for this research were derived from “An Evaluation of Sex Workers Health Access (AESHA),” an open community-based prospective cohort of on- and off-street sex workers in Metro Vancouver in the period from January 2010 to February 2016. On a semi-annual basis, participants completed interviewer-administered questionnaires, which involved questions concerning their work environment, criminalization, health, and safety, and included spatial measures of work environment (e.g., places of servicing and soliciting clients, violence, policing). Interviews were conducted in English or Mandarin by trained interviewers including experiential (sex workers) and nonexperiential staff with extensive community experience. As previously described, the study was overseen by a large Community Advisory Board and was based on close collaboration with local community partners including sex workers, women’s support groups, and HIV agencies (Anderson et al., 2015; Goldenberg, Silverman, Engstrom, Bojorquez-Chapela, & Strathdee, 2014). The study holds ethical approval from the Research Ethics Boards at Providence Health Care/University of British Columbia and Simon Fraser University.

Cohort inclusion criteria involved self-identifying as women (cisgender and transgender women), being 14 years of age or older, and exchanged sex for money in the past 30 days. During the informed consent process, study staff thoroughly explained all study procedures, risks, and benefits, and all

participants provided written informed consent prior to enrollment. Through time-location sampling, sex workers were recruited through regular community-based outreach to public/outdoor settings (e.g., streets, alleys), diverse indoor sex work venues (e.g., massage parlors, micro-brothels, other in-call locations), and online (Shannon et al., 2007). Study participants completed questionnaires at study offices in Metro Vancouver or during outreach visits to their work or home location. Participants received Can\$40 per visit for their participation, time, and expenses.

Outcome Variable

The outcome variable (workplace neighborhood mobility) was defined as whether participants reported one or more changes in their primary neighborhood of servicing/soliciting clients between any two study visits during the study period and was coded as a binary variable (yes vs. no). Place of work included the primary locations of soliciting and servicing clients provided in participants questionnaire responses. The study was conducted within Metro Vancouver, which consists of the City of Vancouver and its bordering municipalities (e.g., Burnaby, Surrey). The City of Vancouver is geographically divided into 24 neighborhoods, and for the purpose of this analysis, bordering municipalities were considered as individual neighborhoods for a total of 46 neighborhoods within our study area.

Independent Variables

Independent variable selection was informed a priori hypotheses based on previous research highlighting how mobility within the context of sex work is influenced by factors at multiple levels (J. Y. Choi, 2009; Goldenberg, Chettiar, et al., 2014; Platt et al., 2012; Ragsdale, Anders, & Philippakos, 2007; Ramesh et al., 2012; Swain, Saggurti, Battala, Verma, & Jain, 2011; Yi et al., 2010), including individual (e.g., age, Indigenous ancestry) and structural (e.g., policing, violence, working conditions, access to health care) determinants. These variables have been shown to act as both “pull” and “push” factors. All variables, at different factor levels, are clearly outlined in Table 1. Time-independent measures considered at baseline included sociodemographic characteristics such as age, gender/sexual orientation, Indigenous, im/migrant status, and level of education. All other variables were considered as time-dependent measures asked at each study visit and referred to occurrences within the previous 6 months.

Individual and sociodemographic variables included age (in years), identifying as a gender/sexual minority (with lesbian, gay, bisexual, transgender,

Table 1. Baseline Characteristics of Sex Workers (N = 543) in Metro Vancouver Between 2010 and 2016, Stratified by Workplace Neighborhood Mobility.

Workplace Neighborhood Mobility			
Variables	Yes	No	p value
	n (%)	n (%)	
	n = 264 (48.6%)	n = 279 (51.4%)	
Individual			
Age, years, median (IQR)	34 (28-42)	37 (29-43)	.007
Gender/sexual minority			
LGBTQ2S and other	99 (37.5)	84 (30.1)	.069
Straight and cisgender	165 (62.5)	195 (69.9)	
Indigenous			
Yes	111 (42.1)	117 (41.9)	.979
No	153 (58.0)	162 (58.1)	
Im/migrant to Canada			
Yes	56 (21.2)	72 (25.8)	.199
No	208 (78.8)	206 (73.8)	
Education (completed high school)			
High school graduate	140 (53.0)	139 (49.8)	.455
Less than high school	124 (47.0)	140 (50.2)	
Noninjection drug use ^a			
Yes	189 (71.6)	183 (65.6)	.116
No	74 (28.0)	96 (34.4)	
Injection drug use ^a			
Yes	127 (48.1)	115 (41.2)	.107
No	137 (51.9)	164 (58.8)	
Self-rated health is better/same than 6 months ago ^a			
Yes	214 (81.1)	237 (85.0)	.265
No	49 (18.6)	42 (15.1)	
Structural			
Income Can\$, ^a median (IQR)	2,400 (1,200-4,200)	2,000 (1,000-4,000)	.297
Physical/sexual workplace violence ^a			
Yes	44 (16.7)	45 (16.1)	.804
No	216 (81.8)	234 (83.9)	
Client condom refusal ^a			
Yes	48 (18.2)	40 (14.3)	.263
No	202 (76.5)	219 (78.5)	

(continued)

Table 1. (continued)

Workplace Neighborhood Mobility			
Variables	Yes	No	p value
	n (%)	n (%)	
	n = 264 (48.6%)	n = 279 (51.4%)	
Homeless ^a			
Yes	79 (29.9)	50 (17.9)	.001
No	185 (70.1)	226 (81.0)	
Have access to health services when needed ^a			
Yes	239 (90.5)	249 (89.3)	.427
No	22 (8.3)	29 (10.4)	
Primary place of service ^a			
Outdoor	105 (39.8)	81 (29.0)	
Informal indoor	105 (39.8)	118 (42.3)	.001
Indoor in-call	46 (17.4)	74 (26.5)	.007
Police harassment (without arrest) ^a			
Yes	76 (28.8)	73 (26.2)	.476
No	187 (70.8)	206 (73.8)	
Rushed client negotiations because of police presence ^a			
Yes	96 (36.4)	92 (33.0)	.371
No	166 (62.9)	187 (67.0)	
Police presence affected where you worked ^a			
Yes	107 (40.5)	104 (37.3)	.416
No	156 (59.1)	175 (62.7)	
Red zones/legal restrictions affected where you worked ^a			
Yes	11 (4.2)	5 (1.8)	.110
No	237 (89.8)	252 (90.3)	
Moved neighborhood of work because of safety concerns ^a			
Yes	26 (9.9)	15 (5.4)	.056
No	225 (85.2)	245 (87.8)	

Note. All measures refer to *n* (%) unless otherwise noted. Column percentages may not sum to 100% due to missing observations. IQR = interquartile range; LGBTQ2S = lesbian, gay, bisexual, transgender, transsexual, queer, questioning, and 2-spirit.

^aRefers to 6 months prior to the interview.

transsexual, queer, questioning, and 2-spirit [LGBTQ2S], or other considered as “yes” vs. straight and cisgender, which were coded as “no”), identifying as Aboriginal/Indigenous (yes vs. no), being an im/migrant to Canada (born outside of Canada, yes vs. no), level of education (high school graduate vs. less than high school), substance use (including separate measures of use of

noninjection and injection drugs, which were coded as yes vs. no), and self-rated health (defined as whether their health was perceived to be better/same than 6 months ago, yes vs. no).

Structural factors considered included average monthly income from non-government sources (Can\$; continuous), physical or sexual violence at work (defined as “yes” to any of “abducted/kidnapped,” “attempted sexual assault,” “raped,” “strangled,” “physically assaulted/beaten,” “locked/trapped in a car,” “thrown out of moving car,” “assaulted with weapon”; yes vs. no), client condom refusal (yes vs. no), homelessness (yes vs. no), and access to primary health care services when needed (yes vs. no). Primary type of place of servicing clients was coded as outdoor/public space (e.g., street) versus informal indoor (e.g., single room occupancy [SRO] housing, bar, hotel, apartment, nightclub), or formal in-call space (e.g., massage/beauty parlor, micro-brothel). Several measures of criminalization and displacement developed based on substantial input from sex workers and sex work support organizations locally were considered, including experiencing police harassment while working without being arrested (e.g., “told to move on,” “police raid,” “threatened with arrest/detainment/fine,” “searched,” “followed,” “picked up and driven elsewhere to work,” “verbally harassed,” “parked nearby/drove by repeatedly,” “detained,” “physically assaulted,” “drugs/drug use equipment taken,” “condoms taken,” “searched for condoms,” “other property taken,” “propositioned to exchange sex,” “coerced into providing sexual favors”; yes vs. no), rushing negotiations with clients due to police presence (yes vs. no), reporting that police presence affected where you work (yes vs. no), having red zones/legal restrictions affect where you work (yes vs. no), and changing the neighborhood in which you work because of safety concerns (yes vs. no). Our variable examining exposure to end-demand legislation periods was defined as the period postimplementation (April 2015–2016) in comparison with the period prior to implementation (January 2010–December 2013); 2014 and early 2015 data were excluded as laws criminalizing sex workers were struck down at the end of 2013 and the new laws were not put into place until the end of 2014.

Statistical Analysis

Descriptive statistics were calculated to examine differences in potential independent variables of interest according to whether or not participants had changed the neighborhood of their primary work environment between study visits. The Mann–Whitney test was used for continuous variables and the Pearson’s chi-square test (or Fisher’s exact test for small cell counts) were used to assess categorical variables.

Bivariate and multivariable logistic regression with generalized estimating equations (GEE; Ballinger, 2004; Hanley, Negassa, & Forrester, 2003) was used to model individual and contextual factors correlated with workplace neighborhood mobility over the 6-year study period. GEE was used to account for repeated measurements of the same subjects across multiple study visits, and analyses were performed with a logit link function and an exchangeable correlation structure. Explanatory variables associated with workplace neighborhood mobility at a significance level of $p < .10$ in bivariate analyses were considered for inclusion in the multivariable model. Identification of the best-fitting multivariable model was conducted using a manual backward model selection process, as indicated by the lowest quasi-likelihood under the independence model criterion (QIC) value (Pan, 2001). All p values are two-sided, and all statistical analyses were conducted in SAS 9.4 (©SAS Institute Inc., SAS 2015).

Given the concern that changes in criminalization patterns related to the implementation of end-demand legislation might influence patterns of mobility and displacement over time, we also conducted a sensitivity analysis to assess potential changes in neighborhood mobility between the pre- versus post-law implementation periods among sex workers interviewed during both time periods.

Spatial Analysis

Mapping technology using Environmental Systems Research Institute (ESRI; 2012) ArcGIS 10.3 was used to explore, visualize, and highlight patterns of neighborhood mobility, including the neighborhoods between which participants moved most often during the study period.

Spatial variables collected within the AESHA questionnaire include places of service, solicitation and residence, as well as locations of violence, policing, and other structural measures and are collected at baseline and at each follow-up visit based on address or cross street. For this analysis, spatial data on place of service and solicitation were geocoded and assigned to the neighborhood where it was located. Locations were then updated and mapped for each time period and coded to indicate whether a participant had changed the neighborhood of their primary work environment. Patterns of in- and out-migration (i.e., net out-migration vs. in-migration among sex workers for each catchment area) were calculated and visually examined to identify the neighborhoods that experienced the largest differences in these measures. Within the identified neighborhoods, a hotspot analysis using kernel density techniques was applied to visually explore and represent locations within neighborhoods with high rates of net in- and out-migration.

Results

A total of 543 sex workers who provided a specific location of solicitation and/or service in at least two separate study visits were included in the analysis, who contributed 2,199 observations over a median follow-up period of 24 (interquartile range [IQR] = 6-40) months. Of those, 402 (74.0%) had changed the neighborhood of their primary work environment between study visits at least once over the course of the 6-year study.

The participants' median age was 36 years at baseline (IQR = 28-43), 33.7% ($n = 183$) self-identified as a gender/sexual minority and 23.6% were im/migrants to Canada. About 35.3% of the sample reported primarily servicing clients in outdoor/public spaces, 41.1% in informal indoor spaces, and 22.1% in in-call environments at first follow-up (Table 1).

In bivariate analysis, participants who were older (odds ratio [OR] = 0.98/year older, 95% confidence interval (CI) = [0.97, 0.99]) and were im/migrants to Canada (OR = 0.70, 95% CI = [0.52, 0.94]) had lower odds of neighborhood mobility. Women who self-identified as a gender/sexual minority (OR = 1.41, 95% CI = [1.11, 1.81]), were homeless (OR = 1.62, 95% CI = [1.28, 2.04]), or experienced workplace physical and/or sexual violence (OR = 1.30, 95% CI = [1.01, 1.69]) had higher odds of experiencing neighborhood mobility. Those who reported rushing negotiations with clients because of police presence also had higher odds of neighborhood mobility (OR = 1.17, 95% CI = [0.96, 1.42]), as did those exposed to police harassment (without being arrested; OR = 1.24, 95% CI = [1.03, 1.51]), whose work location was affected by police presence (OR = 1.29, 95% CI = [1.06, 1.57]), or who changed their neighborhood of work due to safety concerns (OR = 1.53, 95% CI = [1.08, 2.18]). Servicing primarily in outdoor/public spaces was correlated with higher odds of workplace neighborhood mobility in comparison with those servicing in informal indoor or in-call settings (OR = 1.62, 95% CI = [1.35, 1.96]). Finally, there was no difference in neighborhood mobility rates pre- and postimplementation of end-demand legislation (2010-2013 vs. 2015-2016). All other variables were not significantly related to neighborhood mobility (Table 2).

In multivariable GEE analysis (Table 2), neighborhood workplace mobility was negatively correlated with age (adjusted odds ratio [AOR] = 0.98, 95% CI = [0.97, 0.99]), whereas homelessness (AOR = 1.43, 95% CI = [1.12, 1.82]), identifying as a gender/sexual minority (AOR = 1.31, 95% CI = [1.04, 1.70]), and servicing clients in outdoor/public places (AOR = 1.48, 95% CI = [1.21, 1.81]) were correlated with enhanced neighborhood mobility. Finally, exposure to police harassment (AOR = 1.19, 95% CI = [0.96, 1.48], $p = .11$) and moved neighborhood of work due to safety concerns (AOR = 1.37, 95% CI = [0.94, 2.00], $p = .09$) were both marginally correlated with neighborhood mobility.

Table 2. Variables Correlated With Moving Primary Neighborhood of Solicitation/Service Among Sex Workers in Metro Vancouver Over Time ($N = 543$, 2,199 observations), 2010-2016.

Variables	OR	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Individual		
Younger age	0.98 [0.97, 0.99]	0.99 [0.97, 1.00]
Gender/sexual minority	1.41 [1.11, 1.81]	1.31 [1.02, 1.67]
Indigenous	1.11 [0.87, 1.41]	—
Im/migrant to Canada	0.70 [0.52, 0.94]	—
Education	1.13 [0.89, 1.43]	—
Noninjection drug use ^a	1.13 [0.90, 1.42]	—
Injection drug use ^a	1.11 [0.91, 1.36]	—
Self-rated health is better/same than 6 months ago ^a	0.85 [0.69, 1.06]	—
Structural		
Income (per Can\$1,000) ^a	1.02 [1.00, 1.04]	—
Physical/sexual workplace violence ^a	1.30 [1.01, 1.69]	—
Client condom refusal ^a	1.14 [0.92, 1.42]	—
Homeless ^a	1.62 [1.28, 2.04]	1.41 [1.11, 1.79]
Have access to health services when needed ^a	0.87 [0.63, 1.20]	—
Primary place of service: outdoor (vs. informal indoor or indoor in-call) ^a	1.62 [1.35, 1.96]	1.48 [1.21, 1.81]
Police harassment (without arrest) ^a	1.24 [1.03, 1.51]	1.19 [0.96, 1.48]
Rushed negotiation with client because of police presence ^a	1.17 [0.96, 1.42]	—
Police presence affected where you worked ^a	1.29 [1.06, 1.57]	—
Red zones/legal restrictions affected where you worked ^a	0.95 [0.58, 1.54]	—
Moved neighborhood of work because of safety concerns ^a	1.53 [1.08, 2.18]	1.37 [0.94, 2.00]

Note. Gender/sexual minority: LGBTQ2S or others versus straight and cisgender woman. OR = odds ratio; CI = confidence interval; LGBTQ2S = lesbian, gay, bisexual, transgender, transsexual, queer, questioning, and 2-spirit.

^aRefers to 6 months prior to the interview.

The spatial analysis of neighborhood mobility patterns indicated that sex workers located in the City of Burnaby (a suburban community adjacent to the

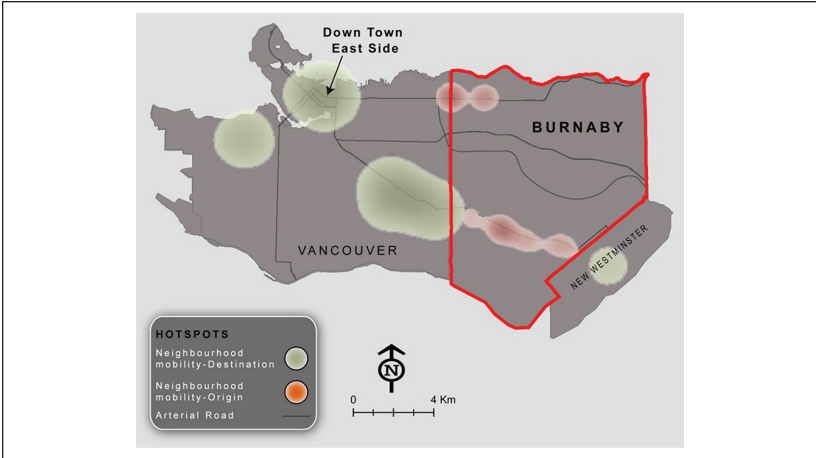


Figure 1. Kernel density map illustrating hotspots of workplace neighborhood mobility among sex workers who worked within the City of Burnaby (2010-2016, $N = 183$).

Note. Data in this figure include only those sex workers who solicited and/or serviced in the City of Burnaby between 2010 and 2016. Red hotspots indicate areas with the highest net rate of outward mobility while the green hotspots depict areas with the greatest net rate of in-migration during the study period. This figure shows high rates of work-related out-migration from the City of Burnaby into the City of Vancouver. As our modeling shows, out-migration was likely due to police harassment and unsafe environment. The DTES neighborhood is characterized by high rates of urban poverty, marginalized or unstable housing, and highly concentrated and visible substance use and indoor and outdoor sex work scenes. In contrast, the suburban community of Burnaby is home to large immigrant/newcomer populations and has more dispersed sex work and drug use scenes, with a greater proportion of sex work taking place in indoor in-call environments (e.g., massage parlors). DTES = Downtown Eastside.

City of Vancouver) experienced the highest rate of outward mobility (i.e., instances of workplace neighborhood mobility), during the study period ($n = 84$ vs. $n = 64$; Figure 1). Other municipalities with high rates of participant in- and out-migration included Kensington-Cedar Cottage ($n = 112$ vs. $n = 88$) and the Downtown Eastside (DTES) neighborhood ($n = 267$ vs. $n = 230$). Figure 1 show a kernel density map of participants who moved in and out of the City of Burnaby. Among participants who engaged in sex work in Burnaby, those who relocated had primarily moved to neighborhoods within the City of Vancouver, including downtown, the DTES, or the Kingsway Corridor. Figure 2 shows a kernel density map of participant in- and out-migration within the City of Vancouver. The City of Vancouver, particularly the DTES neighborhood, experienced the greatest amount of mobility in absolute numbers.

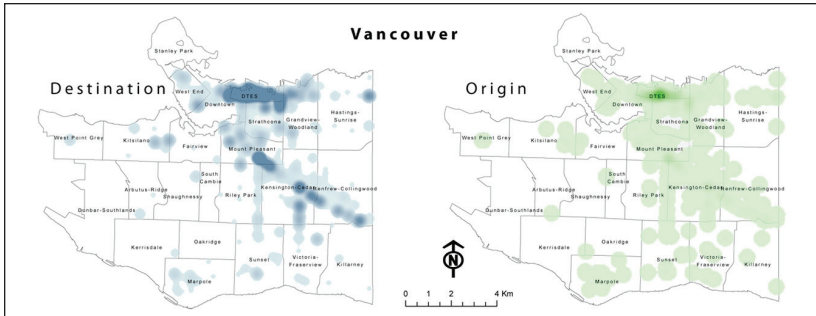


Figure 2. Kernel density map illustrating hotspots of workplace neighborhood mobility among sex workers who worked within the City of Vancouver (2010–2016; $N = 543, 2,199$ observations).

Note. This figure includes only those sex workers who solicited and/or serviced within the City of Vancouver from 2010–2016. Blue hotspots indicate areas of inward mobility while green hotspots depict areas of outward mobility within the study period. Most inward mobility is concentrated in the DTES neighborhood. The DTES neighborhood is characterized by high rates of urban poverty, marginalized or unstable housing, and highly concentrated and visible substance use and indoor and outdoor sex work scenes. DTES = Downtown Eastside.

Discussion

Over the course of this 6-year study, three quarters of sex workers changed their primary neighborhood of work; these women were more likely to be younger, homeless, identify as a gender/sexual minority, service in outdoor/public settings, and experience police harassment. Similar to other studies, the results of our study indicate that although many sex workers, including youths, may engage in work-related mobility for new opportunities, others may change work environments due to displacement stemming from concerns related to policing, violence, and unsafe working conditions (Goldenberg, Chettiar, et al., 2014; Ramesh et al., 2012; Reed et al., 2012; Shannon et al., 2008). Finally, no difference in mobility patterns was found postimplementation of end-demand sex work criminalization ($OR = 0.79, 95\% CI = [0.57, 1.08], p = .13$), which may be explained by prior research showing that various models of sex work criminalization, including shifts toward “end-demand” legislation globally, often similarly undermine sex workers’ access to health and safety, including through displacement of sex work transaction spaces and work environments due to fear of criminalization of sex workers, clients, or third parties (Krüsi et al., 2014; Platt et al., 2018). This suggests that despite the purported aim of this legislation to protect the welfare of marginalized communities, the implementation of the new laws did not reduce displacement experiences among sex workers during our study.

Younger sex workers within our study were more likely to experience workplace neighborhood mobility. Prior studies have shown that youth often engage in mobility to seek out new experiences, improved working conditions, enhanced earnings, and new employment opportunities (Althorp, 2013; Goldenberg, Chettiar, et al., 2014). Our study also found that identifying as a gender/sexual minority was linked to increased odds of workplace neighborhood mobility, which is supported by results from qualitative work conducted in the Vancouver area, in which trans sex workers experienced displacement as a result of criminalization, gentrification, unsafe working conditions, and broader experiences of social exclusion (Lyons, Krüsi, Pierre, Small, & Shannon, 2017). Studies from other settings have demonstrated that sex workers who identify as gender/sexual minorities often experience higher mobility (Cai et al., 2016; Husakouskaya, 2017; Rana et al., 2016); this has been previously linked to the fact that trans workers often experience high levels of stigma, discrimination, poverty, social exclusion, and social isolation, and a lack of acceptance within local communities (e.g., cisgender and/or gay communities), which may contribute to enhanced mobility (Husakouskaya, 2017). Trans sex workers may face distinct restrictions on the geographical areas in which they can work; for example, in Vancouver, there exist “designated” areas for trans workers that may limit this population’s ability to move about other neighborhoods in search of work (Lyons et al., 2017). Interestingly, although LGBTQ2S people make up only 10% of the general population, 33.7% of the participants in our study identified as LGBTQ2S. Further research and efforts to understand experiences of mobility and displacement among this population and links to health and safety remain needed to inform evidence-based programs.

In addition, our analysis showed that moving due to a perceived lack of safety, workplace physical/sexual violence, and exposure to police harassment (without arrest) were marginally correlated with increased odds of workplace neighborhood mobility. This work builds on previous findings from the global south (Swain et al., 2011) and uniquely highlights the connection between law enforcement interactions, working conditions, and urban mobility among marginalized women within high-income countries such as Canada. In India, studies have also shown associations between work-related mobility and workplace violence (Swain et al., 2011), as well as between migration for sex work and violence (Ramesh et al., 2012). However, contextual factors that shape sex workers mobility will likely be different between the global South and North. Our findings suggest that sex workers who change the primary area in which they work may do so largely due to displacement to more unsafe and isolated spaces resulting from criminalized interactions with law enforcement, which has been previously shown to be a

critical barrier to health and safety (Goldenberg et al., 2017; Shannon et al., 2008). It is possible that those engaged in work-related mobility may also experience reduced access to peer supports upon arrival to new work areas as well as less information or familiarity with local workspaces, which may contribute to unsafe working conditions (Goldenberg, Chettiar, et al., 2014). Several other studies suggest that sex workers who are highly mobile may experience unsafe working conditions and enhanced susceptibility to violence (Ramesh et al., 2012; Saggurti et al., 2008, 2012). Previous epidemiological research with sex workers in Canada demonstrated that sex workers who engaged in short-term sex work-related mobility outside of Vancouver faced almost twice the odds of workplace violence as their nonmobile counterparts (Goldenberg, Chettiar, et al., 2014); however, this previous work did not include mapping and did not focus on urban mobility patterns.

Complementing results of our statistical analysis, our spatial analysis is unique in its use of kernel density mapping within the context of sex work and provides novel insights into the social geography of neighborhood mobility and displacement patterns among sex workers in Metro Vancouver over a 6-year period of time. Mapping results indicate that the City of Burnaby experienced the highest rate of outward mobility of all the cities/neighborhoods included in our study and that the City of Vancouver, particularly the DTES neighborhood, experienced the most mobility activity in absolute numbers. The observed movement from Burnaby to Vancouver may partly be explained by differences in law enforcement between municipalities, including those related to the introduction of end-demand legislation in 2014 (Chu & Canadian HIV/AIDS Legal Network, 2014; Initiative, Gender and Sexual Health, 2014; Perrin, 2014). For example, the Vancouver Police Department has adopted enforcement guidelines that purportedly consider sex work between consenting adults to no longer be an enforcement priority and announced that it would not enforce the federal law; although these policy-level decisions have not always translated to improvements “on the ground,” it is possible that the absence of such policies in surrounding municipalities, such as Burnaby, could potentially render the City of Vancouver to be a relatively less punitive environment for sex work than its surrounding municipalities (Pablo, 2015).

To promote sex workers' occupational safety and human rights, steps to promote safer and more supportive working conditions remain critically needed, particularly for marginalized subpopulations of youth, gender/sexual minorities, and those experiencing homelessness; policy reforms need to shift away from enforcement-based approaches and end-demand criminalization toward community-based and sex worker-led initiatives that focus on protecting sex workers' rights and workplace safety. Tailored efforts to address the unique needs of mobile sex workers who are operating in new environments

or neighborhoods are also recommended to promote well-being and reduce isolation, including through peer-based outreach to workspaces and linkage to supportive and sex worker–friendly community-based health and social supports. The use of mapping techniques, such as those used in this study, can assist in targeting programs and policies to the areas of greatest need.

Strengths and Limitations

This study has several strength and limitations that should be noted. Our prospective design allowed us to examine correlates of neighborhood mobility over a 6-year observation period, whereas most prior research on mobility among marginalized populations rely upon cross-sectional designs. Variables originated from self-reported data, which are often cited to be subject to reporting bias. However, community-based relationships with the participants are likely to minimize this bias, as our frontline staff receive extensive training and have ample experience in building rapport and maintaining meaningful connections with participants. Our analysis adopted a unique spatial epidemiological approach to understand not only the characteristics of sex workers who engage in workplace mobility, but also the social geography of work-related mobility patterns across Metro Vancouver neighborhoods.

Furthermore, the study uses highly accurate locational and questionnaire data measured over a relatively long time span to understand sex workers' mobility patterns and determinants. As such, our sample was restricted to those who provided valid spatial data across at least two study visits on places of servicing and/or soliciting clients, thereby reducing power for some analyses. As our spatial data captured only those movements that occurred within the last month and which involved a move from primary place of solicitation and/or service, further longitudinal research focused on longer term experiences of displacement and other forms of displacement (e.g., place of residence) is recommended. In addition, future studies focused on assessing the impact of mobility-related processes on health care utilization and health outcomes among sex workers within urban environments remain needed to inform health services delivery efforts.

Conclusion

Over the course of this 6-year study, almost three quarters of our study participants changed the neighborhood within which they primarily worked at least once; these women were more likely to be younger, homeless, and identify as a gender/sexual minority and service clients in outdoor/public settings. They were also marginally more likely to experience police harassment and to report moving work neighborhoods because they felt unsafe. To ensure sex

workers' occupational safety and rights, steps to reduce vulnerability to violence and ensure access to safer in-call workspaces remain critically needed, including moving away from enforcement-based criminalization toward community-based and sex workers-led initiatives that focus on protecting sex workers' rights and safety. Special efforts to address the needs of youth, gender/sexual minorities, and precariously housed women, as well as mobile sex workers who are operating in new work environments or neighborhoods, are also recommended to promote well-being and reduce isolation.

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