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Fentanyl Overdose Concerns Among People Who Inject Drugs: The Role of Sex, Racial Minority Status, and Overdose Prevention Efforts

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Abstract

Background: People who inject drugs (PWID) have an elevated risk of fentanyl-related overdoses. This study explores fentanyl overdose concerns among PWID and the role of sex, racial minority status, and overdose prevention efforts in these concerns.

Methods: Data were from 498 PWID from Baltimore City, MD, recruited using street-based outreach between 2016–2019. Multinomial logistic regressions assessed correlates of participants' level of concern for themselves and their peers overdosing from fentanyl.

Results: A third of participants were female, half were Black, over two-thirds perceived fentanyl to be in all/most of heroin, 40% expressed low fentanyl overdose concern, and a third overdosed in the past six months. After controlling for socio-demographic characteristics, female sex was associated with being very concerned about fentanyl overdoses for oneself (aRR:2.14; 95%CI:1.22,3.71) and peers (aRR:1.98; 95%CI:1.14,3.45). Compared to Black participants, White participants were less likely to be very concerned about fentanyl overdoses for themselves (aRR:0.35; 95%CI:0.19,0.65). Participants who often/always carried naloxone (aRR:2.91; 95%CI:1.42,5.95) perceived fentanyl in most heroin (aRR:2.78; 95%CI:1.29,5.97) or were on medications for opioid use disorder (Quite a bit concerned aRR:2.18; 95%CI:1.28,3.69; Very concerned: aRR:1.96; 95%CI:1.19,3.22) were more likely than their counterparts to report being concerned for their peers, but not for themselves.

Conclusion: Female sex and racial minority status were associated with greater concern regarding fentanyl overdoses for oneself. Increasing overdose deaths in these populations suggests disparate access to harm reduction initiatives rather than interest or concern. Furthermore, findings on naloxone, medications for opioid use disorder, and concerns for peers support social-network-based interventions among PWID.

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Keywords

substance use; women; race; fentanyl; overdose

1. Introduction

Fentanyl Trends and Overdose Deaths

Over 81,000 individuals died of a drug overdose in 2020, the largest amount in 12 months in United States history (El-Bassel & Shoptow, 2021; Ahmad et al., 2020; CDC, 2020). These deaths are increasingly attributed to fentanyl, a synthetic, fast-acting opioid 50–100 times more potent than morphine; fentanyl-related deaths outpaced deaths attributed to prescription opioids and heroin (Colon-Berezin et al., 2019; Zibbell et al., 2019; Somerville et al., 2017). Specifically, overdose deaths from synthetic opioids such as fentanyl increased by 525% from 2013 to 2016, and by 2019, these deaths were over 12 times higher than in 2013 (CDC, 2021; Zibbell et al., 2019; Jones, Einstein, & Compton, 2018). While a minority of people who use drugs prefer drugs containing fentanyl, Park and colleagues (2019) found that many people who use drugs are unaware of its presence, potency, and potentially deadly effects.

Naloxone, MOUD, and Overdose Deaths

Effective strategies to curb opioid overdose deaths and related adverse outcomes by reducing opioid use include medications for opioid use disorders (MOUD) such as suboxone, methadone, and buprenorphine (Brezel, Powell & Fox, 2020; Pro et al., 2020; Wakeman et al., 2020). In addition, naloxone, an opioid antagonist that can reverse opioid overdoses, plays a critical role in reducing fentanyl-related deaths. In numerous studies, an increase in naloxone distribution decreased or averted rises in opioid overdose deaths (Naumann et al., 2019; McDonald, Campbell, & Strang, 2017; Davidson, Wheeler, Proudfoot, Xu & Wagner, 2015). Overall, individuals are over five times more likely to survive an opioid overdose if naloxone is administered (Barboza et al., 2020). Due to the potency of fentanyl, quick administration and multiple doses of naloxone may be needed to reverse an overdose attributed to a synthetic opioid, underscoring the need for access to naloxone among people who inject drugs (PWID) (Somerville et al., 2017).

Socioeconomic Status, Sex, Racial Minority Status, and Overdose Deaths

While MOUD and naloxone play significant roles in reducing opioid overdose deaths, access to these life-saving treatments is associated with markers of social disadvantage, such as lower socioeconomic status (SES), sex, racial minority status, geography, and insurance coverage (Jones et al., 2021; Dayton et al., 2020; Huhn et al., 2020; Lambdin et al., 2018; Madden & Qeadan, 2020; Green et al., 2017). Under-resourced, low-income communities are known to have lower drug quality and greater contamination coupled with less access to MOUD and naloxone, leading to more fatal drug overdoses (Sawyer et al., 2021; Marsh et al., 2021; Ray et al., 2020; Nesoff et al., 2021). Moreover, significant sex (biological differences between males and females) and gender (culturally defined roles of men and women) differences contribute to disparate substance use outcomes (NIDA, 2020).

Compared to men, women may progress to addiction faster and have heightened sensitivity to substances due to hormones, more cravings, more relapses during and after substance use treatment, and increased risk of fatal drug overdoses (NIDA, 2020; Barbosa-Leiker et al., 2018).

In addition to sex differences in substance use outcomes, Barboza and colleagues (2020) documented racial disparities in overdose deaths in the absence of naloxone; however, no racial differences in the likelihood of surviving an overdose when naloxone was administered were present. Consequently, compared to Non-Hispanic White individuals, drug overdose deaths are increasing for racial minorities, although White individuals are more likely to use opioids than other racial groups (Cano, 2021; Larochelle et al., 2021; Schuler et al., 2021). The increase of fentanyl presence and related overdose deaths, along with disparate access to life-saving treatments, conjures interest in assessing concerns about fentanyl overdoses among vulnerable PWID.

Current Study

The current fentanyl epidemic in the United States has disproportionately affected the Eastern states, with the vast geographic differences in opioid overdose deaths explained mainly by a disproportionately high presence of fentanyl in this geographic area (Zoorob, 2019). Thus, our study location of Baltimore, MD, which is heavily affected by opioid use and fentanyl (Latkin et al., 2019), provides a unique context for exploring fentanyl concerns among PWID. As such, this study examines the prevalence of fentanyl overdose concerns among PWID and the role of sex, racial minority status, naloxone, and medications for opioid use disorder (MOUD) in these concerns.

Theoretical Framework

This study is guided by a risk perception framework as found in behavioral models such as the Health Belief Model (HBM), a theoretical framework that suggests an individual's perceptions of a threat of illness or health consequences may motivate them to adopt certain behavior changes to reduce their risk (Champion & Skinner, 2008). Specific to this study, we assess the level of concern about fentanyl overdose, which corresponds with the HBM constructs of perceived susceptibility—the subjective perception that one is vulnerable to adverse outcomes associated with a health behavior—and perceived severity—the subjective perception of the seriousness of adverse health outcomes related to the health behavior (Champion & Skinner, 2008).

2. Methods

2.1 Study Overview

We used data from 498 PWID recruited from Baltimore City, MD, between 2016–2019 for a randomized control trial to prevent and treat HIV/HCV (Dayton et al., 2019). To be eligible for the study, participants had to: be 18 years of age or older, have a history of injection drug use, reside in the study area, and provide informed consent. Participants were recruited using a combination of street-based recruitment in Baltimore City, MD, by trained study staff. Trained study staff conducted interviews using ACASI and collected

information on past and current drug use, injection drug use (IDU), fentanyl concerns, overdose history and concerns, MOUD, naloxone, sociodemographic characteristics, and other related information. All study protocols were approved by Johns Hopkins University Bloomberg School of Public Health Institutional Review Board.

2.2 Measures

To assess the topics of interest, the following items were used:

Fentanyl Overdose Concerns for Self: The item "How worried are you about overdosing on fentanyl?" was our first outcome of interest. Based on response options and distribution, the original four-level response options were collapsed into a three-level variable denoting 1) not at all worried or just a little worried, 2) quite a bit worried, and 3) very worried.

Fentanyl Overdose Concerns for Peers: The item "How worried are you about a drug buddy (friend) overdosing on fentanyl?" was our second outcome of interest, with the same four response options collapsed similarly into three levels.

Perceived Fentanyl Prevalence in Heroin: "What percentage of heroin on the streets of Baltimore do you think contains fentanyl?" To create a more parsimonious model, the original response options of none--0%, some--25%, about half--50%, most--75%, or all--100%, were condensed into a three-level variable denoting less than half, about half, and most/all (75%+).

MOUD: Participants responded to the question, "Are you taking any of the following medications to treat a drug addiction?" with possible responses of Buprenorphine, Suboxone, Methadone, Naltrexone, or some other medication. Participants who reported taking any of these medications were categorized as taking MOUD.

Naloxone Carrying: In response to the question, "How often do you carry Narcan with you?" possible options of never, rarely, or sometimes were combined and contrasted with responses of often or always.

Past 6 months Overdose: Participants were asked, "When was your most recent overdose?" The responses within the last month, within the last 6 months, within the last year, and one year or more were recategorized as a binary variable denoting past 6-month overdose vs. over 6 months since last overdose or no overdose.

Sociodemographic Characteristics: These items were used to denote social disadvantage, that is, racial and sex marginalization and social-economic status: Self-reported race (Black, White, or other racial groups), sex (male or female), unstable housing in the prior 6 months (homeless or non-homeless), educational attainment (less than high school, high school or GED, or some college+), age (continuous in years), current employment status (unemployed or employed), and relationship status (in a relationship or single).

2.3 Statistical Analysis

The original sample recruited for the parent trial consisted of 657 index participants. For this analysis, the following sample restrictions were imposed. For all analyses, we excluded n=83 participants who had not used any drugs in the past 6 months and a further n=76 individuals due to missing data on key variables of interest (i.e., missing both outcome variables; missing race). Thus, analyses predicting fentanyl overdose concerns for peers are based on n=498 PWID. Fentanyl overdose concerns for self were only asked among those who engaged in IDU in the past 6 months; thus, analyses predicting fentanyl overdose concerns for self are based on the n=347 PWID with recent IDU.

Analyses for both outcomes proceeded in two steps. First, the bivariate associations between fentanyl overdose concerns and the correlates of interest were assessed with Pearson's Chi-Square tests and one-way ANOVAs. Second, predictors of fentanyl overdose concerns for oneself and peers who used substances were assessed with two multinomial logistic regression models, including variables in these models associated with the outcomes in the bivariate analyses at the $p<0.10$ level.

3. Results

3.1 Sociodemographic Characteristic of Samples

Among the 498 PWID used to assess overdose concerns for peers who used substances (Table 1), the average age was 46; a third were female (33%) and most self-identified as Black PWID (59%). Participants' socioeconomic statuses were low. Around one-third reported less than a high school education (35%), 44% reported a high school equivalent education, and 21% reported some college-level education. Around half identified as homeless (54%), 93% identified as unemployed, and 25% reported being in a relationship. In addition, 26% reported past 6 months overdose, most perceived fentanyl in most/all of Baltimore's heroin supply (65%), 61% were currently on MOUDs, and 25% of the sample reported often/always carrying naloxone.

Regarding overdose concerns for peers who used substances, about one-quarter reported no/little concern (22%), 32% reported being quite a bit concerned. In comparison, 46% reported being very concerned about their peers overdosing from fentanyl. In bivariate models, sex, relationship status, perceived presence of fentanyl in Baltimore's heroin supply, naloxone carrying, and MOUDs were significantly associated with greater concern about fentanyl overdose for peers who used substances.

The sociodemographic characteristics of the 347 PWID who engaged in IDU within the past 6 months were nearly identical to the sample used to assess concerns for peers (Table 1). However, the level of concern for personally having a fentanyl-related overdose varied. Less than half (40%) of those who injected in the past 6 months reported little or no concern, 18% reported being quite a bit concerned, and 42% reported being very concerned. Of the above social and substance use-related factors, age, sex, education, and race were associated with fentanyl overdose concerns for self in bivariate analysis. Since 90% of our sample were unemployed, the variation of income and employment was too little to be included in our predictive modeling. Still, we were able to assess age, race, gender, and

educational attainment in subsequent regression models, even in this highly restricted range of respondents' SES, and found differences that may help guide overdose prevention and treatment programs.

3.2 Multinomial Regression Predicting Fentanyl Overdose Concerns for Peers Who Use Substances

Only factors associated at the p-value level of 0.1 or less in bivariate analyses were included in the multinomial regression models (Table 2). The multinomial regression predicting fentanyl overdose concerns for peers (Table 2) showed that females, compared to males (Very concerned aRR 1.98, 95% CI: 1.14, 3.45), and PWID with a high school equivalent education, compared to PWID with less education (Quite a bit concerned: aRR 1.89, 95% CI: 1.03, 3.46), were nearly twice more likely to report being concerned for their peers than to report no/little concern. Moreover, perceptions of fentanyl prevalence, MOUD, and naloxone carrying were significantly associated with overdose concerns for peers who use substances. PWID who perceived fentanyl to be in most/all of Baltimore's heroin supply, compared to PWID who perceive fentanyl to be in less, were nearly three times more likely to report being very concerned about their peers overdosing than to report no/little concern (aRR 2.78, 95% CI: 1.29, 5.97). PWID who were currently on MOUD, compared to PWID who were not, were two times as likely to report being quite a bit or very concerned about their peers overdosing from fentanyl exposure than to report no/little concern (Quite a bit concerned: aRR 2.18, 95% CI: 1.28, 3.69; Very concerned: aRR 1.96, 95% CI: 1.19, 3.22). PWID who always/often carried naloxone were also three times more likely to report being very concerned about their peers overdosing from fentanyl than to report no/little concern (aRR 2.91, 95% CI: 1.42, 5.95). PWID who identified as Non-Black or White, compared to Black PWID, were less likely to report being very concerned about their peers overdosing than reporting no/little concern (aRR 0.25, 95% CI: 0.09, 0.71).

3.3 Multinomial Regression Predicting Level of Fentanyl Overdose Concerns for Oneself

Among PWID who injected in the past six months, multinomial regressions revealed that socio-demographic factors were significantly associated with levels of concern for personally overdosing from fentanyl (see Table 2). Older PWID, compared to younger PWID (aRR 1.03, 95% CI: 1.00, 1.05), and females, compared to males (aRR 2.13, 95% CI: 1.22, 3.72), were more likely to report being very concerned about overdosing from fentanyl than reporting no/little concern. PWID with some college education, compared to PWID with less than high school education, were significantly less likely to be concerned about overdosing from fentanyl (Quite a bit concerned: aRR 0.27, 95% CI: 0.10, 0.75; Very concerned: aRR 0.27, 95% CI: 0.13, 0.55). Compared to Black PWID, White PWID (Very concerned: aRR 0.35, 95% CI: 0.19, 0.65) and PWID who identified as neither Black nor White (Quite a bit concerned: aRR 0.36, 95% CI: 0.07, 0.59) were also less likely to report being concerned about overdosing from fentanyl than reporting no/little concern. Unlike the model predicting fentanyl overdose concerns for peers, fentanyl presence, MOUD, and naloxone carrying were not significantly linked with levels of fentanyl overdose concern for oneself.

4. Discussion

4.1 Perceived Risk of Fentanyl Overdose

This study examined sex, racial minority status, overdose prevention efforts, and overdose concerns among PWID, a group at high risk for experiencing a fentanyl overdose. While most participants (70%) perceived fentanyl to be in all or most heroin, 40% of recently injecting PWID reported no/little concern for themselves overdosing from fentanyl. Conversely, only half that number (22%) reported no/little concern for their peers who used substances overdosing from fentanyl. These findings are alarming as they suggest that those vulnerable to fentanyl-related overdoses may not perceive their vulnerability. Our results corroborate those of Moallef et al. (2019), who found that even among people who use drugs and have high fentanyl risk knowledge, most did not translate that knowledge into personal overdose risk. However, two-thirds of the Moallef et al. (2019) sample reported never or rarely using opioids, further highlighting the importance of our current study among those using opioids (Latkin et al., 2019).

Moreover, Soukup-Baljak and colleagues (2015) found that social-network-based information on drug contamination, quality, and related health information was most effective and trusted among people who use drugs. This finding suggests that social-network-based interventions can be a promising avenue to increase the perceived susceptibility and severity of fentanyl-related overdoses. In a previous analysis, we found that PWID were very willing to communicate with their peers about fentanyl (Latkin et al., 2019). Alternatively, the lower levels of concerns for fentanyl overdoses for oneself may be attributable to trust in the sources from which PWID obtain drugs. In research by Soukup-Baljak and colleagues (2015) and Mcknight and Des Jarlais (2018), drug dealers labeled by PWID as trusted and reputable were a primary avenue used by PWID to reduce fentanyl exposure and overdoses. Using peer and social-network-based interventions to advocate for overdose precautions that highlight the limitations of using perceived trustworthiness of drug dealers to prevent fentanyl exposure and overdose risk may be warranted.

4.2 Perception of Fentanyl Presence, Naloxone, and Fentanyl Overdose Concerns

Consistent with the lower levels of fentanyl concerns, the rates of often carrying naloxone were meager. While around 30% of our sample of PWID overdosed in the past 6 months, and the majority believed fentanyl was present in most or all of the heroin in Baltimore, less than a quarter of participants often carried naloxone. This finding corroborates with research by Gicquelais et al. (2019), which found that among a large sample of people who use opioids, only 56% could identify naloxone as an opioid overdose treatment, despite most experiencing an overdose. However, perceiving fentanyl in most or all heroin and carrying naloxone were strong predictors of PWID concern for peers. This suggests that increased awareness of the risk of fentanyl and PWID susceptibility and their peers to fentanyl overdoses may increase willingness to carry naloxone often. Interestingly, naloxone carrying was not associated with the level of fentanyl overdose concerns for oneself among those who recently engaged in IDU. Additional awareness that carrying naloxone may enable bystanders to save their own lives in the event of an overdose may also increase naloxone carrying among PWID.

4.3 MOUD and Fentanyl Overdose Concerns

Similar to the magnitude of naloxone carrying and its link with fentanyl overdose concerns for others, PWID being treated with MOUD were significantly more likely to report being concerned for their peers on both levels of concern than to report no/little concern. This finding suggests that similar to the social responsibility aspect of carrying naloxone, being treated with MOUD may also increase the social responsibility for peers' welfare. However, participants treated with MOUD who recently injected were not significantly more likely than those not being treated with MOUD to be concerned for themselves regarding fentanyl overdose. This finding may underscore the need to highlight that MOUD and other harm reduction treatments reduce but do not eliminate the risk of overdose. As such, caution and awareness of susceptibility should be addressed.

4.4 Sex, Racial Minority Status, Other Social Factors, and Overdose Concerns

In addition to substance use-related correlates to fentanyl overdose concerns, sex and racial minority status were also associated with fentanyl overdose concerns. Women were significantly more likely than men to be concerned for themselves and their peers regarding fentanyl overdoses. This finding is consistent with previous literature indicating that women tend to be more concerned about health issues and follow health recommendations more than men (Vaidya, Partha, & Karmakar, 2012). Moreover, gender norms reinforce images of women as caretakers and thus may contribute to women's increased concern for their peers (Meyer et al., 2019). This finding may help explain prior research that found that women are significantly more likely to carry naloxone than men (Dayton et al., 2019).

In addition to sex, interesting findings on race and fentanyl overdose concerns were evident. White PWID were significantly less likely to be very concerned about overdosing from fentanyl than Black PWID. Prior research has suggested that social disadvantage factors may lead to drug supplies in minority communities being tainted more frequently with fentanyl than in other communities (Ray et al., 2020). Racial differences in drug supply quality have been blamed for increasing drug overdose deaths of Black individuals (Ray et al., 2020). Our findings suggest that Black PWIDs' increased level of concern parallels their actual greater risk of overdose.

Along with sex and racial minority differences in concern, the varying levels of fentanyl overdose concerns may also be linked with disparate access to life-saving naloxone. Prior research has found that Black individuals are less likely to have access to naloxone and be administered naloxone—even by EMS (Dayton et al., 2020; Jones et al., 2021; Ray et al., 2020). However, our findings support that Black PWID are even more concerned about overdosing themselves and are as likely as White PWID to be concerned for their peers. This suggests that the increasing overdose deaths among Black individuals are more likely to reflect disparate access to harm reduction initiatives rather than a lack of interest or concern. Park and colleagues (2019) found that among PWID, females, racial minorities, and those who perceived fentanyl contamination in drugs were more likely to endorse willingness to use a safe consumption site. These findings, along with those of the current study, highlight the importance of harm-reduction programs and initiatives for minority communities and other socially disadvantaged groups.

4.5 Limitations and Strengths

Our study findings should be interpreted in consideration of the limitations of this study. Our study included self-report data on sensitive topics and a non-random sample in one city, and concerns about overdose and awareness of both fentanyl and opioid antagonists like naloxone may have increased since these data were collected. Moreover, our study assesses participants' concern for themselves and their peers overdosing on fentanyl—and not health behavior engagement, HBM constructs such as perceived benefits, perceived barriers, cue to action, and self-efficacy were not included. While this study was not a formal test of HBM, findings suggest that models such as the HBM should include gender and race as key factors and also highlight the need for harm reduction for services for racial groups facing steep increases in fentanyl-overdose deaths. In addition to the limitations stated above, race/ethnicity may be confounded with social disadvantage, and findings should be contextualized within this limitation. Despite these limitations, our study boasts several strengths, including a large sample size of PWID and detailed items on fentanyl concerns. Our study period coincides with dramatic fentanyl-related increases in overdose deaths in Baltimore City, MD. Specifically, in 2014 and 2015, fentanyl-related deaths were 24% and 30% of all overdose deaths in Baltimore; however, this number jumped to 60% in 2016, with steady increases thereafter (Gross, 2020). As such, this study provides timely insights into the fentanyl overdose epidemic in a severely impacted area.

5. Conclusion

In our study of 498 PWID from Baltimore City, MD, most participants perceived fentanyl to be in all or most of heroin; however, the level of concern for fentanyl-related overdose varied. PWID who often carried naloxone, were being treated with MOUD, or perceived a high presence of fentanyl in heroin were more likely to be concerned for their peers. Only markers of social disadvantage predicted the level of PWID concern for overdosing on fentanyl themselves. Understanding the mechanisms behind different levels of concern may aid harm reduction initiatives.

Overall, research has found that PWID employ multiple individual-level strategies (e.g., naloxone, test shots, trusted drug dealers) to prevent overdoses; however, societal and structural factors such as poverty, stigma, employment opportunities, and accessibility to drug treatment and related services impede the consistency of using these strategies (McKnight & Des Jarlais, 2018). Community-level interventions focused on distributing naloxone have been implemented in areas suspected of high fentanyl contamination with success and should be implemented in other areas of need to prevent overdose deaths (Rowe et al., 2019).

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Public Health Significance:

Female sex and racial minority status were associated with greater concern regarding fentanyl overdoses for oneself. Increasing overdose deaths in these populations suggests disparate access to harm reduction initiatives rather than interest or concern.

Table1:

Bivariate Associations of Risk Factors with Fentanyl Overdose Concerns for Self and Peers

	Fentanyl Worry – Self (N=347)					Fentanyl Worry – Peers (N=498)				
	Overall N (%)	**None/Little 139 (40%)**	**Quite a bit 63 (18%)**	**Very 145 (42%)**	**P**	**Overall N (%)**	**None/Little 110 (22%)**	**Quite a bit 158 (32%)**	**Very 230 (46%)**	**p**
Age, M (SD)	43 (10.8)	41 (10.9)	43 (12.1)	46 (9.4)	**<0.001**	46 (10.8)	43 (11.3)	46 (11.6)	46 (10.0)	0.07
Sex										
Male	239 (69%)	106 (76%)	47 (75%)	86 (59%)	**0.005**	336 (68%)	85 (77%)	115 (73%)	136 (59%)	**0.001**
Female	108 (31%)	33 (24%)	16 (25%)	59 (41%)		162 (33%)	25 (23%)	43 (27%)	94 (41%)	
Education										
>High School	121 (35%)	39 (28%)	19 (30%)	63 (44%)	**<0.001**	174 (35%)	42 (38%)	43 (27%)	89 (38%)	0.10
HS/GED	156 (45%)	55 (40%)	38 (60%)	63 (44%)		220 (44%)	45 (41%)	83 (53%)	92 (40%)	
Some College+	70 (20%)	45 (32%)	6 (10%)	19 (13%)		104 (21%)	23 (21%)	32 (20%)	49 (21%)	
Homeless										
No	143 (41%)	55 (40%)	23 (37%)	65 (45%)	0.469	231 (46%)	53 (48%)	69 (43%)	109 (47%)	0.70
Yes	204 (59%)	84 (60%)	40 (64%)	80 (55%)		267 (54%)	57 (51%)	89 (56%)	121 (52%)	
Unemployed **										
No	23 (7%)	10 (7%)	5 (9%)	8 (5.6)	0.754	35 (7%)	7 (6%)	11 (7%)	17 (8%)	0.93
Yes	320 (93%)	127 (93%)	57 (92%)	136 (93.3)		458 (93%)	102 (94%)	147 (93%)	209 (93%)	
Race										
Black	174 (50%)	50 (36%)	29 (46%)	95 (66%)	**<0.001**	295 (59%)	58 (53%)	94 (60%)	143 (62%)	0.06
White	150 (43%)	76 (55%)	32 (51%)	42 (29%)		176 (35%)	40 (36%)	58 (37%)	78 (34%)	
Other	23 (7%)	13 (9%)	2 (3%)	8 (5%)		27 (5%)	12 (11%)	6 (4%)	9 (4%)	
In Relationship										
No	258 (74%)	100 (72%)	49 (79%)	109 (75%)	0.65	374 (75%)	85 (77%)	130 (82%)	159 (69%)	**0.01**
Yes	89 (26%)	39 (28%)	14 (22%)	36 (25%)		124 (25%)	25 (23%)	28 (18%)	71 (31%)	
Past 6 Month Overdose										
No	237 (68%)	95 (68%)	48 (76%)	94 (65%)	0.27	370 (74%)	81 (74%)	119 (75%)	170 (74%)	0.94
Yes	110 (32%)	44 (32%)	15 (24%)	51 (35%)		128 (26%)	29 (26%)	39 (25%)	60 (26%)	
Perceived Fentanyl in Heroin										
Less than half	41 (12%)	16 (12%)	7 (11%)	18 (12%)	0.99	60 (12%)	19 (17%)	24 (16%)	17 (7%)	**<0.01**

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	Fentanyl Worry – Self (N=347)					Fentanyl Worry – Peers (N=498)				
	Overall N (%)	**None/Little 139 (40%)**	**Quite a bit 63 (18%)**	**Very 145 (42%)**	**P**	**Overall N (%)**	**None/Little 110 (22%)**	**Quite a bit 158 (32%)**	**Very 230 (46%)**	**p**
About half	68 (20%)	27 (19%)	13 (21%)	28 (19%)		112 (22%)	33 (30%)	30 (19%)	49 (21%)	
Most/all	238 (69%)	96 (69%)	43 (68%)	99 (68%)		326 (65%)	58 (53%)	104 (66%)	164 (71%)	
MOUD										
No	134 (39%)	53 (38%)	24 (38%)	57 (39%)	0.98	193 (39%)	57 (52%)	54 (34%)	82 (36%)	**<0.01**
Yes	213 (61%)	86 (62%)	39 (62%)	88 (61%)		305 (61%)	53 (48%)	104 (66%)	148 (64%)	
***Often/Always Carry Naloxone**										
No	251 (75%)	107 (80%)	45 (75%)	99 (70%)	0.183	380 (78%)	95 (89%)	122 (79%)	163 (72%)	**0.003**
Yes	84 (25%)	27 (20%)	15 (25%)	42 (30%)		106 (22%)	12 (11%)	32 (21%)	62 (28%)	

** n=5 missing

*** n=12 missing

Table 2:

Multinomial Regressions Predicting Fentanyl Overdose Concerns for Self and Peers

	Fentanyl Worry – Self (N=347) Reference: None/Little				Fentanyl Worry-Peers (N=486) Reference: None/Little			
	Quite a bit		Very		Quite a bit		Very	
	aRR	*95% CI*	*aRR*	*95% CI*	*aRR*	*95% CI*	*aRR*	*95% CI*
Age	1.02	.99,1.05	**1.03**	**1.00, 1.05**	1.02	.99, 1.06	1.02	0.99, 1.07
Sex								
Male	REF	--	REF	--	REF	--	REF	--
Female	1.04	0.51, 2.14	**2.13**	**1.22, 3.72**	1.24	0.68, 2.27	**1.98**	**1.14, 3.45**
Education								
> HS	REF	--	REF	--	REF	--	REF	--
HS Equivalent	1.46	0.71, 2.97	0.89	0.49, 1.60	**1.89**	**1.03, 3.46**	0.96	0.54, 1.69
Some college+	**0.27**	**0.10, 0.75**	**0.27**	**0.13, 0.55**	1.43	0.69, 2.97	0.95	0.49, 1.88
Race								
Black	REF		REF	--	REF	--	REF	--
White	0.81	0.39, 1.68	**0.35**	**.19, 0.65**	0.77	0.40, 1.47	0.81	0.44, 1.50
Other	0.36	0.07, 0.59	0.40	0.14, 1.12	**0.29**	**0.09, 0.87**	**0.25**	**0.09, 0.71**
OD 6 months	0.74	0.36, 1.51	1.58	0.91, 2.75	1.96	0.53, 1.75	1.06	0.61, 1.87
In Relationship	---	---	---	---	0.67	0.35, 1.27	1.29	0.72, 2.29
Perceived Fentanyl in Heroin								
Less than half	---	---	---	---	REF	--	REF	--
About half	---	---	---	---	0.73	0.32, 1.68	1.61	0.70, 3.75
Most/all	---	---	---	---	1.32	0.63, 2.74	**2.78**	**1.29, 5.97**
MOUD	---	---	---	---	**2.18**	**1.28, 3.69**	**1.96**	**1.19, 3.22**
Carry Naloxone					2.09	0.98, 4.46	**2.91**	**1.42, 5.95**

aRR= Adjusted Relative Risk