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Non-Fatal Stimulant Overdose among Homeless and Unstably Housed Women in San Francisco, California

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Abstract

Background: US rates of overdose deaths involving stimulants (e.g., cocaine or methamphetamine) have increased, but little is known about non-fatal stimulant overdoses, particularly among vulnerable populations. We characterized rates of non-fatal stimulant overdose identified outside of health care settings among women at high risk.

Methods: Homeless and unstably housed women in San Francisco, California using stimulants were administered questionnaires on drug use and outcomes (stimulant overdose, health care utilization) monthly for six months. Based on pilot interviews, stimulant overdose during follow-up was defined as acute toxicity from stimulant use ("over-amping") resulting in "feeling sick, really scared, or like one's life may be in danger". Poisson regression estimated unadjusted incidence rate ratio (IRR) comparing participant characteristics.

Results: We included 160 women (41% Black, 26% White, 15% Latina, median age 54 years) using crack cocaine (81%), methamphetamine (48%), and powdered cocaine (36%). Participants reported 67 non-fatal stimulant overdoses over 685 person-months of observation, a rate of 117.4 per 100 person-years (95% CI 85.8–160.5). Rates were higher among participants who were Latina vs. White (IRR 4.18 [1.60–10.94]), used methamphetamine (IRR 1.80 [0.96–3.38]), or

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CONTRIBUTORS

All authors have contributed to the work and approved the final version.

CONFLICT OF INTEREST

No conflict declared.

used any stimulant daily/almost daily (IRR 2.63 [1.41–4.91]). Among women reporting stimulant overdose, 4% received emergency and 3% inpatient care for overdose of any drug.

Conclusions: Women in this setting, particularly those who used stimulants frequently or used methamphetamine, experienced high non-fatal stimulant overdose and rarely received health care for these events. Efforts should be made to increase awareness and reduce harms of stimulant toxicity in vulnerable populations.

Keywords

stimulant; cocaine; methamphetamine; overdose; homeless; unsheltered; women; HIV

1. INTRODUCTION

US rates of stimulant-involving overdose have increased sharply, reaching, in 2017, 4.3 deaths and 11.3 emergency department (ED) visits per 100,000 persons for cocaine, and 3.2 deaths and 13.6 ED visits per 100,000 for psychostimulants including methamphetamine (Kariisa et al., 2019; Vivolo-Kantor et al., 2020a; Vivolo-Kantor et al., 2020b). Stimulant-involving overdose is a leading cause of death among homeless persons (Baggett et al., 2013; Riley et al., 2013). Few other studies have examined stimulant overdose, particularly non-fatal overdose, in at-risk populations rather the general population (Kaye and Darke, 2004). Stimulant use resulting in non-fatal overdose still poses substantial health risks including myocardial infarction, stroke, and cognitive deficits (Lange and Hillis, 2001; Paulus and Stewart, 2020). Persons who use stimulants may be at risk of other adverse health outcomes, such as opioid overdose due to co-use or contamination, and reduced antiretroviral adherence for persons with HIV (Lee et al., 2019; Mattson et al., 2021). Understanding the burden of non-fatal stimulant overdose is thus essential to evaluate its potential health impact and identify unmet clinical or harm reduction needs.

Recent epidemiological evidence on non-fatal stimulant overdose rates is limited by the use of ED visit data, which may not capture all events (Vivolo-Kantor et al., 2020a; Vivolo-Kantor et al., 2020b). Stimulant overdose presentation can vary substantially, with symptoms that may not manifest immediately following use or be recognized as overdose-related (Lange and Hillis, 2001; Paulus and Stewart, 2020; Riley et al., 2013). Persons using stimulants may not consider that stimulant overdose is possible or seek medical attention when experiencing toxicity symptoms (Riley et al., 2013). Researchers and clinicians using the term “overdose” may therefore undercapture adverse stimulant use outcomes when interacting with persons who use stimulants.

Leveraging qualitative pilot studies, we examined non-fatal stimulant overdose, defined as acute stimulant toxicity based on the experience and terminology of persons who use stimulants (Riley et al., 2013). We characterized rates and risk factors of non-fatal acute stimulant toxicity, and overdose-related health care utilization, among homeless and unstably housed women in San Francisco, California.

2. METHODS

Data came from a cardiac injury study called Polysubstance Use and Health Outcomes Evaluation (PULSE) (Riley et al., 2020). Between June 2016 and January 2019, trained research staff recruited women from shelters, free meal programs, single room occupancy hotels (SROs), street encampments, and the Zuckerberg San Francisco General Hospital HIV clinic. Inclusion criteria were: female birth sex, age ≥18 years, and history of housing instability (i.e., slept in a shelter, street, abandoned building, vehicle, or stayed with series of associates because they had nowhere else to sleep). Women with HIV were oversampled to achieve HIV-specific aims. At monthly visits for six months, we collected blood specimens for drug and cardiac biomarker testing and administered questionnaires including items on drug use and health care utilization, using audio computer-assisted self-interviewing (ACASI) for sensitive questions. Participants provided written, informed consent and were compensated $40 per visit. To maximize retention, participants received multiple reminder calls and could reschedule visits if needed. The University of California, San Francisco Institutional Review Board approved the study. This study included women reporting any past-year stimulant use at the initial visit (baseline). Each visit counted as one person-month of follow-up. The primary outcome was non-fatal stimulant overdose, defined as acute stimulant toxicity (“over-amping”) based on prior qualitative work, i.e., taking enough of a stimulant to “feel sick, really scared, or like one’s life may be in danger” (Supplemental Table 1) (Riley et al., 2013). Secondary outcomes were ED visit and hospitalization, for any cause and accidental drug overdose (Supplemental Table 1). Participants were not asked about the specific drug causing the overdose leading to ED visit or hospitalization. For each outcome, each visit where a participant reported having the outcome in the past month counted as one event. Participants reporting acute stimulant toxicity in the past week were asked about common symptoms.

Covariates measured through baseline questionnaires were: sociodemographics, past-month health insurance coverage and housing instability, and other past-year drug use. HIV testing was conducted at study screening.

To compare acute stimulant toxicity rates by participant characteristics, we estimated unadjusted incidence rate ratios (IRRs) with Poisson regression, using generalized estimating equations to account for repeated events. We also fit a multivariable model including race/ethnicity, methamphetamine use, and daily/almost daily use of any stimulant, to further evaluate the associations of these factors together with acute stimulant toxicity rates. *P* values were two-sided with a pre-specified alpha of 0.05. Analyses were conducted in Stata v16.0 (StataCorp, College Station, TX).

3. RESULTS

We included 160 women with past-year stimulant use, who were 41% Black, 26% White, 15% Latina, a median of 54 years old, and 34% HIV-seropositive (interquartile range [IQR] 46–59) (Table 1). Participants reported using a median of 2 stimulants (IQR 1–3) in the past year, most commonly crack cocaine (81%), methamphetamine (48%), and powdered cocaine (36%). Fourteen percent reported injection drug use. Daily/almost daily stimulant use was

reported by 55% of participants overall, and 50%, 45%, and 11%, of those using crack cocaine, methamphetamine, and powdered cocaine, respectively (Supplemental Table 2). Other past-year substance use included tobacco (87%), cannabis (77%), and heroin (25%). Five (3%) women tested positive for fentanyl or fentanyl metabolites. Drug use varied by race/ethnicity (Supplemental Table 3).

Participants completed 685 of 960 possible study visits (71%; median 5 visits per participant). Two deaths occurred during follow-up; cause of death was not known. Over 685 person-months, 43 participants reported experiencing 67 acute stimulant toxicity events ("over-amping"), a rate of 117.4 per 100 person-years (95% confidence interval [CI] 85.8–160.5). The most common symptoms were racing heart (69%), extreme nervousness/anxiety (69%), and paranoia (69%) (Table 2).

IRRs of acute stimulant toxicity were 1.52 (95% CI 0.58–3.99) for Black and 4.18 (1.60–10.94) for Latina versus White women (Table 1). Rates were higher for participants who used methamphetamine (IRR 1.80 [0.96–3.38]) or any stimulant daily/almost daily (IRR 2.63 [1.41–4.91]). Compared to women who only used crack cocaine, those who used methamphetamine and heroin were likelier to experience acute stimulant toxicity (IRR 5.46 [3.24–9.19]). Other characteristics were not associated with acute stimulant toxicity. In a multivariable model, the IRRs were 1.60 (0.70–3.65) for methamphetamine use and 2.06 (0.83–5.15) for daily/almost daily use, and estimates for race/ethnicity were similar to unadjusted results.

All-cause ED visit and hospitalization rates were 262.8 (214.2–322.4) and 105.1 (77.0–143.5) per 100 person-years, respectively. For overdose of any drug, ED visit and hospitalization rates were 14.0 (6.6–30.0) and 8.8 (3.1–24.4) per 100 person-years, respectively. Of 67 visits where women reported an acute stimulant toxicity event in the past month, 4% and 3% reported an overdose-related ED visit and hospitalization, respectively, in the past month.

4. DISCUSSION

In San Francisco, homeless and unstably housed women using stimulants experienced a rate of 117 acute stimulant toxicity events per 100 person-years, or >1 annually on average, and rates were higher for women who were Latina, used methamphetamine, or used any stimulant daily/almost daily. Although ED visit and hospitalization rates were high overall, very few women reporting acute stimulant toxicity received overdose-related emergency or inpatient care.

Growing evidence shows the burden of stimulant-related overdose deaths among vulnerable US populations, particularly women. In San Francisco, homeless women have high death rates, with 50% from cocaine-involving intoxication; in SROs, recent mortality rates from cocaine- and methamphetamine-involving overdoses were 135 and 97 per 100,000 persons, respectively (Riley et al., 2013; Rowe et al., 2019). Among US women aged 30–64 years, overdose mortality has increased in the past 20 years, particularly cocaine-involving deaths (VanHouten et al., 2019). Overdose mortality in Boston's homeless population in 2003–

2008 was 242 deaths per 100,000, with 37% involving cocaine (Baggett et al., 2013). Our findings extend these studies by highlighting the frequency of non-fatal adverse events of stimulant use in a high-risk population. Additionally, prior research in vulnerable and general populations generally used *International Classification of Diseases* coding from ED visits or death registries. We used questionnaires on drug toxicity symptoms administered prospectively to women in the community, comprehensively evaluating acute stimulant toxicity events, including those that do not lead to health care or death.

We found higher acute stimulant toxicity rates among Latina versus White women, including when adjusting for methamphetamine use and frequent use of any stimulant. Previous population-based studies examining overdose mortality have not reported higher rates among Latinx persons for stimulant- or opioid-involving overdose (Kariisa et al., 2019; Scholl et al., 2018; Seth et al., 2018). Studies on non-fatal overdose rates have generally used data sources with no or incomplete information on race and ethnicity (Liu et al., 2020; Vivolo-Kantor et al., 2020a; Vivolo-Kantor et al., 2020b). Future studies should focus on elucidating causes of racial/ethnic disparities in non-fatal stimulant overdose, and additional efforts to collect race/ethnicity data are needed.

Low overdose-related health care utilization in our study is consistent with qualitative work showing that persons using stimulants may not seek medical care for toxicity symptoms (Riley et al., 2013). However, women in our study had high all-cause ED visit and hospitalization rates, presenting opportunities for intervention. Identifying persons using stimulants during ED visit or hospitalization could help link patients to drug use disorder treatment, harm reduction resources, and preventative care for cardiovascular and other complications. Opioid overdose prevention efforts may also be needed, even among women primarily using stimulants, as one-quarter of our study participants also used heroin. ED visits for non-fatal stimulant overdose are associated with >3-fold increase in subsequent opioid overdose death (Krawczyk et al., 2020). Additionally, opioids can be mixed with or mistaken for stimulants. In the US, half of deaths and one-quarter of ED visits due to stimulant-related overdose also involve an opioid (Kariisa et al., 2019; Vivolo-Kantor et al., 2020a).

Although acute stimulant toxicity rates did not differ by HIV status in our study, women with HIV using stimulants may benefit from further efforts to improve HIV-related and other health outcomes. Persons with HIV, especially women, are at higher cardiovascular risk than persons without HIV (Chow et al., 2012; Freiberg et al., 2013; Marcus et al., 2014). Cocaine use is also among the primary myocardial infarction causes not related to atherosclerosis among persons with HIV (Crane et al., 2017). Given the acute and long-term cardiovascular effects of stimulants, efforts to identify and address stimulant use in vulnerable women with HIV may be appropriate. Additionally, efforts to support viral suppression and provide harm reduction resources for women who use stimulants and inject drugs can prevent sexual and injection-related HIV transmission (Abdul-Quader et al., 2013; Cohen et al., 2016).

This study's strengths include recent and detailed data on drug use and health care utilization, collected through ACASI to reduce social desirability bias, from a community-based sample of women at high risk. A particular strength is that data on non-fatal stimulant

overdose were collected prospectively, using questionnaires informed by the experience and terminology of persons using stimulants.

One limitation is the small sample size. Nevertheless, we identified several factors associated with stimulant overdose. Because stimulant overdose symptoms are non-specific, it is possible that rates in this study are overestimated. However, even with substantial misclassification (e.g., only 50% of outcomes were true overdoses), rates would remain high (i.e., 60 per 100 person-years). Conversely, by counting at most one outcome per month, rates may be underestimated if women experienced more than one stimulant toxicity event. Rates could also be underestimated if women who died or had missed visits were likelier to overdose, or if some women in our sample with past-year stimulant use had discontinued use. Another limitation is that symptom data was only available for the past week, not the past month as with our primary outcome. Furthermore, while cardiac symptoms of stimulant toxicity are consistent with studies on causes of stimulant-involving deaths, the clinical significance of other self-reported symptoms is not well known and merits further study (Darke et al., 2017; Turner et al., 2018). Finally, we examined a sample of unstably housed women from a single city, with a median age of 54. Our findings may not be generalizable to other populations who use stimulants, particularly younger men who have sex with men, persons with stable housing, and those residing in different regions, who may have different drug use practices and supply, physiological response to stimulants, and cardiopulmonary risk factors (e.g., smoking) (Compton and Jones, 2021; Jones et al., 2020; Mustaquim et al., 2021).

5. CONCLUSIONS

Unstably housed women in San Francisco experienced 117 non-fatal stimulant overdoses, defined as acute stimulant toxicity, per 100 person-years, and few women sought medical attention for these. Interventions in community and emergency care settings should focus on reducing adverse health outcomes among persons using stimulants, especially subgroups at higher risk, by raising awareness of stimulant toxicity, providing harm reduction resources, and linking persons to medical care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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HIGHLIGHTS

- Unstably housed women had high rates of non-fatal stimulant overdose.
- Rates were higher for women who used stimulants frequently or used methamphetamine.
- Rates were also higher for women who identified as Latina vs. White.
- Few women reporting stimulant overdoses received health care for these events.

Table 1.

Baseline characteristics and factors associated with non-fatal stimulant overdose rates, among 160 women with unstable housing reporting stimulant use in the past year at baseline, San Francisco, California, 2016–2019. Non-fatal stimulant overdose was defined as acute toxicity from stimulant use ("over-amping") resulting in "feeling sick, really scared, or like one's life may be in danger".

Characteristic at baseline	N (%)	Unadjusted IRR (95% CI) [a]	Adjusted IRR (95% CI) [b]
Age, years			
18–39	23 (14%)	1 (ref.)	
40–49	34 (21%)	1.17 (0.48, 2.84)	
50–59	67 (42%)	0.54 (0.23, 1.26)	
≥60	36 (23%)	0.91 (0.33, 2.51)	
Race/ethnicity			
Black	65 (41%)	1.52 (0.58, 3.99)	1.87 (0.73, 4.78)
White	41 (26%)	1 (ref.)	1 (ref.)
Latina	24 (15%)	4.18 (1.60, 10.94)	3.93 (1.57, 9.84)
Multiracial	16 (10%)	2.03 (0.65, 6.33)	2.03 (0.64, 6.44)
Other	14 (9%)	4.88 (1.76, 13.59)	4.23 (1.57, 11.40)
Completed high school/GED	104 (65%)	0.81 (0.43, 1.51)	
HIV positive	54 (34%)	0.80 (0.42, 1.53)	
Insured in past month [c]	151 (94%)	1.72 (0.59, 5.00)	
Housing instability in past month [d]	61 (38%)	1.43 (0.76, 2.68)	
Stimulant use in the past year			
Crack cocaine	129 (81%)	1.02 (0.41, 2.57)	
Powdered cocaine	57 (36%)	1.30 (0.69, 2.48)	
Methamphetamine	76 (48%)	1.80 (0.96, 3.38)	1.60 (0.70, 3.65)
Ecstasy/MDMA	16 (10%)	1.00 (0.39, 2.61)	
Other stimulant	20 (13%)	1.74 (0.84, 3.62)	
Daily or almost daily stimulant use [e]	88 (55%)	2.63 (1.41, 4.91)	2.06 (0.83, 5.15)
Stimulant and heroin co-use			
Crack cocaine only	55 (35%)	1 (ref.)	
Methamphetamine only	15 (9%)	0.38 (0.09, 1.62)	
Crack cocaine and methamphetamine	12 (8%)	0.70 (0.16, 3.01)	
Crack cocaine and heroin	6 (4%)	*f*	
Methamphetamine and heroin	1 (1%)	5.46 (3.24, 9.19)	
Crack cocaine, methamphetamine, and heroin	5 (3%)	1.09 (0.17, 6.98)	
Any other combination	65 (41%)	1.34 (0.68, 2.67)	

Abbreviations: CI, confidence interval; GED, general education degree; IRR, incidence rate ratio; ref., referent.

[a] Estimates and 95% confidence intervals were obtained from separate Poisson regression models with generalized estimating equations to account for participants contributing more than one outcome. All contrasts are "yes vs. no" unless a referent category is specified.

[b] Estimates and 95% confidence intervals were obtained from a single Poisson regression model with generalized estimating equations including race/ethnicity, methamphetamine use, and daily or almost daily use of any stimulant.

[c] Defined as being consistently insured in the past month, including through public programs such as Medicaid.

[d] Defined as staying in a shelter, the street or other outdoor public space, an abandoned building or other indoor public place, or a vehicle in the past month.

[e] Varied by stimulant type, with 50% of participants using crack cocaine reporting daily or almost daily use, 11% for those using powdered cocaine, 45% for those using methamphetamine, 6% for those using ecstasy/MDMA, and 5% for those using other stimulants.

[f] IRR for this combination could not be estimated due to small sample size.

Table 2.

Symptoms of acute stimulant toxicity reported at 29 study visits among women reporting an event in the past week.

Symptoms	N (%)
Any of these symptoms	28 (97%)
Racing heart	20 (69%)
Extreme nervousness or anxiety	20 (69%)
Being suspicious and mistrustful of other when you don't need to be, or paranoia	20 (69%)
Problems breathing or breathing irregularities	19 (66%)
Intense sweating	18 (62%)
Chest pain	17 (59%)
Chest tightness	17 (59%)
Panic	17 (59%)
Jerking or stiff arms and legs	14 (48%)
See things that weren't there, or hallucinations	14 (48%)
Vomiting	13 (45%)
Tremors	10 (34%)
Seizures	9 (31%)
Felt paralyzed or like you couldn't move	8 (28%)