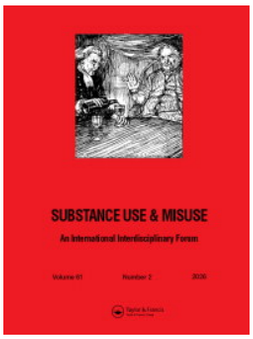

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ORIGINAL ARTICLE

Xylazine Awareness and Suspected Presence in the Illicit Drug Supply Among People Who Used Stimulants in an Overdose Hotspot, 2023

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ABSTRACT

Background: Xylazine is harmful to humans and detected in the United States fentanyl supply and sometimes in stimulants. Awareness of xylazine among people who use stimulants (PWUS) is underexplored.

Methods: In 2023, 59 PWUS in Brockton, Massachusetts, were surveyed about their past 30-day substance use and xylazine awareness. A purposive sub-sample of 21 survey participants completed an in-depth interview, of which 18 discussed xylazine. Chi-square tests assessed global differences in demographics by xylazine awareness. Qualitative data were thematically analyzed by whether participants knew what xylazine was (i.e., xylazine awareness) and past-30-day opioid use – a proxy for xylazine exposure

Results: Twenty-one (35.6%) participants were unaware of xylazine. A greater percentage of Hispanic (58.3%, $n=7$), Black non-Hispanic (50%, $n=7$), and Native American non-Hispanic (100%, $n=2$) participants were unaware of xylazine than White, non-Hispanic participants (17.2%, $n=5$) ($p<0.05$). A greater percentage of participants with less education were unaware of xylazine (62.5%, $n=10$) compared to participants with a high school degree or GED equivalent (37.5%, $n=9$), or some college education (10.5%, $n=2$) ($p<0.05$). Interviews indicated limited xylazine knowledge among those only using stimulants. Participants who intended to use fentanyl but experienced deleterious effects of xylazine, including skin wounds and unexpected sedation, realized post-exposure that xylazine was the likely cause of their adverse use experiences.

Conclusion: Differences in xylazine awareness by substance use, race, and education indicate a need to create literacy-appropriate, culturally relevant xylazine harm reduction messages that are communicated to PWUS by trusted messengers within diverse communities.

KEYWORDS
Adulterant; harm reduction; sedative; stimulants; skin wound; qualitative; xylazine

Introduction

Xylazine, an alpha-2 adrenergic agonist used as a veterinary sedative, is a common adulterant in the unregulated supply of fentanyl in the United States (US). Aside from rare reports of xylazine toxicity in the twentieth century (Zagorski et al., 2023), xylazine in the unregulated drug supply was documented in Puerto Rico in the 2000s, where it was known as *anesthescia de caballo* (horse tranquilizer) (Reyes et al., 2012; Rodríguez et al., 2008). In the early 2020s, the prevalence of xylazine in the unregulated fentanyl supply grew exponentially in the US mainland (Friedman et al., 2022). Since then, xylazine has perfused throughout the fentanyl supply within states in the Northeast US Corridor like Pennsylvania, New Jersey, and Connecticut (Cano et al., 2024). In Massachusetts, community drug checking data from 2020 through 2022 found that the prevalence of xylazine in drug samples sold as fentanyl or heroin increased from 13% to 28% positivity (Massachusetts Drug Supply Stream (MADDS), 2022). By 2024, 590 (51%) of 1158 fentanyl samples submitted for community drug checking in one Massachusetts-based program were positive for xylazine, indicating xylazine's presence in the Massachusetts fentanyl supply, albeit at varied levels (Streetcheck.org, 2025a).

The human use of xylazine is associated with negative health effects on people who use drugs (PWUD). As a non-opioid sedative, xylazine suppresses consciousness (Choi et al., 2023) and naloxone, an opioid antagonist, does not directly reverse xylazine's sedative effect, which has meant that respiratory support and monitoring are increasingly important complements to naloxone when responding to xylazine-involved overdose (Datta et al., 2025; Quijano et al., 2023;

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Zagorski et al., 2023). Xylazine is associated with skin wounds that, if not properly treated, can increase risk of infections that have in some cases resulted in amputation and death (Cervantes et al., 2024; Dowton et al., 2023; Sanchez et al., 2021; Wei et al., 2023; Zabel, 2024). People with xylazine-associated skin wounds face stigma and worry about wound-related appearance changes; accessing social services—an already cumbersome process—is more challenging for those with wounds (Kelly et al., 2024; McFadden et al., 2024). Moreover, emergent qualitative evidence indicates that withdrawal from xylazine-adulterated fentanyl is difficult to manage and more intense than withdrawal from fentanyl without xylazine (Reed et al., 2024; Spadaro et al., 2023), making beginning medications for opioid use disorder more challenging in the era of xylazine (London et al., 2024).

Xylazine-adulterated fentanyl poses serious health risks to PWUD, underscoring the importance of understanding whether people are aware of their risk of xylazine exposure to help inform tailored harm reduction interventions (Kyei et al., 2024). While most extant research has focused on people who use fentanyl (Erath et al., 2024; Hochheimer et al., 2024; Jiang et al., 2024; Park et al., 2024; Quijano et al., 2023; Shrestha et al., 2025), contemporary publicly available or published US-based drug checking work has detected a low but growing prevalence of xylazine in samples submitted as cocaine and amphetamines (most commonly methamphetamine) since 2021 (Martin et al., 2025; Streetcheck.org, 2025a; Wagner et al., 2023). For example, in 2023 15.4% (26/169) of methamphetamine samples and 4.3% (17/299) of cocaine samples collected in Massachusetts, the state the present research occurred in, contained xylazine (Streetcheck.org, 2025a). An analysis of Cook County Medical Examiner data from 2019 through June 30, 2022 found that of 267 xylazine-involved fatal overdoses, 32% involved cocaine (86/267) and 5% involved methamphetamine (13/267) (Delcher et al., 2023). In only rare and sporadic instances has xylazine been detected in stimulants independent of fentanyl (Wagner et al., 2023). The low prevalence of xylazine in stimulants may mean that people who only use stimulants are less likely to be aware that xylazine is present as an adulterant in the drug supply. At the same time, the low prevalence of xylazine in stimulant supplies suggests that exposure may be avoidable if people are aware of their xylazine exposure risk and harm reduction strategies. In knowing this, in 2023 we administered surveys and conducted in-depth interviews with people who use stimulants (PWUS) in Brockton, Massachusetts, a community highly impacted by the overdose crisis and one in which xylazine has been detected, to explore whether people were aware of xylazine in the drug supply and to inform harm reduction messaging for PWUS.

Materials and methods

Setting and procedures

This research is part of a mixed-methods parent study called Preventing Overdoses INvolving stimulanTS (POINTS), which identified risk and protective factors for stimulant and opioid-involved overdose deaths in four New England communities, including Brockton, a city located in Plymouth County, Massachusetts (Hughto, 2024). Xylazine was present in the unregulated fentanyl supply in Plymouth County in 2023 during data collection; 15% of 39 drug samples sold as fentanyl in 2023 obtained in Plymouth County were xylazine positive (Streetcheck.org, 2025a). Accordingly, prior to launching data collection in Brockton, study instrumentation, described in detail below, was modified to include xylazine-specific items to explore whether PWUS in Brockton were aware of xylazine in the drug supply.

In partnership with a community organization operating in Brockton, a modified-respondent-driven sampling approach was used to recruit 59 PWUS from April to May 2023 to participate in interviewer-administered surveys and interviews about drug use and overdose risk (Green, 2020; Green et al., 2021). Eligible participants were at least 18 years of age, self-reported past 30-day use of an illicit stimulant (e.g., powdered and crack cocaine, methamphetamine, or street-obtained prescription stimulants), spoke and understood English or Spanish, lived in or spent most of their time in Brockton, and were able and willing to provide informed consent. A purposive sub-sample ($n=21$) of the 59 survey participants whose survey responses warranted qualitative exploration (e.g., participant had unique or extensive use patterns of stimulants and opioids, overdose experiences, and/or heavily utilized harm reduction and treatment services) participated in an approximately 40-minute in-depth audio recorded interview immediately following the survey. Of the 21 interviewed participants, 18 participants discussed xylazine during the interview, resulting in a qualitative analytic sample of 18 transcripts. Survey participants received $20 cash and interview participants received an additional $20 cash for participating. This study was reviewed and approved by the Brown University Institutional Review Board (protocol number 2111003140).

Measures

Socio-demographics

Age (in years), sex assigned at birth (male; female), race and ethnicity were assessed. Race and ethnicity were combined as Hispanic; White, non-Hispanic; Black, non-Hispanic; Native American, non-Hispanic; and multiracial/ethnic, non-Hispanic. Highest level of education was trichotomized as some high school or less; high school graduate or GED equivalent; and some college or more. Housing status was categorized as living on the street; temporary housing; and in a house/apartment you own or rent.

Substance use history

Past-30-day intentional non-prescribed stimulant use including ecstasy, powder cocaine, crack cocaine, methamphetamine, amphetamines (e.g., Adderall); opioids including heroin, fentanyl, opioid pain medication (e.g., Oxycontin, Percocet); benzodiazepines (e.g., Xanax); non-opioid pain medication (e.g., Gabapentin); gamma-hydroxybutyrate (i.e., GHB); and ketamine was assessed. Past-30-day xylazine use

was not directly assessed given its very recent emergence as an adulterant in the regional drug supply at the time of data collection. Accordingly, we leveraged the substance use variables to stratify participants by opioid use history as a proxy for xylazine exposure because xylazine predominantly appeared as an adulterant in fentanyl at the time of data collection, albeit at modest levels (Kariisa et al., 2023; Streetcheck.org, 2025a). Participants who reported no opioid use in the past 30 days were categorized as no current opioid use, whereas participants who reported past 30-day use of both stimulants and opioids were categorized as used stimulants and opioids past 30 days.

Xylazine awareness

Participants were asked whether they had ever heard of people buying or using drugs that had xylazine (also known as "tranq") in them. Response options included I do not know what xylazine is; yes; no and not sure. This item was recoded into a dichotomous variable to capture xylazine awareness, with participants who responded, I do not know what xylazine is coded as unaware of xylazine, and yes, no, and not sure responses coded as aware of xylazine. The second xylazine item asked whether participants had ever unintentionally bought or used drugs that they later found out or now believed had xylazine or "tranq" in them. Response options included, I do not know what xylazine is; yes; no; and not sure. Participants who responded yes were asked which drugs they purchased that they suspected contained xylazine and when this purchase occurred (in the last week; in the last month; in last year; in the last five years; and more than five years ago).

The interview topic guide questions included, "tell me more about what you know about xylazine (probe about what drugs it is in)"; "have you or anyone you know changed the way that you use drugs because of xylazine? If so, tell me more about that. If not, why?" Participants who disclosed suspected xylazine exposure were asked to describe their substance use experience, including negative aspects (e.g., overdose, skin wounds). In cases where participants did not draw on personal xylazine use experiences, they were asked to describe what they had heard from others in their social network about xylazine use experiences (i.e., some participants shared secondhand accounts of xylazine exposure).

Data analysis

Quantitative analysis

Descriptive statistics, including frequencies, means, standard deviations (SD), medians, and interquartile range (IQR), summarized the frequencies of included socio-demographic and substance use variables. No items were missing responses. Frequencies in demographics are presented by xylazine awareness to facilitate descriptive comparisons. Chi-square (χ^2) and Fisher's exact assessed global differences by xylazine awareness for categorical independent variables, and independent samples t-test was used for age ($p < 0.05$). Quantitative analyses were conducted in SPSS version 29.0.10.

Qualitative analysis

Interviews were transcribed professionally, assigned computer-generated pseudonyms, and uploaded into Dedoose, a secure cloud-based qualitative data analysis platform. A codebook that consisted of deductive codes from the topic guide and inductive codes from an open-coding process was applied to the data by multiple independent coders. Transcripts were not double-coded, but each transcript was discussed with the coding team to improve consistency in code application. Qualitative analysis involved exporting excerpts with a xylazine parent code into a document for iterative analysis. Two survey items were utilized to explore thematic nuance. First, themes were explored by whether participants disclosed xylazine awareness. However, depending exclusively on xylazine awareness could overlook people who were exposed to xylazine, as evidenced by their use experiences, but who do not connect those effects to xylazine because they were unfamiliar with the term. So, we also leveraged the past-30-day opioid use variable alongside the stimulants participants used in the past month to explore how participant experiences differed by drug use history, which allowed for an understanding of how participants' substance use shaped xylazine exposure experiences, regardless of whether participants were aware of their xylazine exposure. In this way, awareness of and experiences with this emergent adulterant were characterized as helping to inform harm reduction messaging about xylazine. Following analysis, the themes were discussed with the interviewers, coders, and study PIs to validate that the themes accurately reflected the data.

Results

Socio-demographics, substance use history, and associations with xylazine awareness

Participants averaged 45 years of age (SD = 10.77), were mostly male (67.8%), and half were people of color (50.8%). Most received at least a high school education or GED equivalent (67.8%). About one-third of survey participants were unaware of xylazine ($n = 21$, 35.6%). A greater percentage of Hispanic (58.3%, $n = 7$), Black non-Hispanic (50%, $n = 7$), and Native American non-Hispanic (100%, $n = 2$) participants were unaware of xylazine than the percentage of White, non-Hispanic participants who were unaware of xylazine (17.2%, $n = 5$) ($p < 0.05$). A greater percentage of participants with some high school education or less were unaware of xylazine (62.5%, $n = 10$) compared to those with a high school degree or GED equivalent (37.5%, $n = 9$), or at least some college education (10.5%, $n = 2$) ($p < 0.05$).

Stimulants used in the past 30 days included crack cocaine ($n = 59$, 100%), powder cocaine ($n = 23$, 39%), amphetamines ($n = 9$, 15.3%), methamphetamine ($n = 7$, 11.9%), and ecstasy ($n = 1$, 1.7%). Most participants also used opioids in the past 30 days ($n = 33$, 55.9%), including fentanyl ($n = 33$, 55.9%), heroin ($n = 23$, 39%), and opioid pain medications ($n = 9$,

15.3). Thus, 33 participants used stimulants and opioids in the past 30 days, whereas 26 participants did not report using opioids in the past 30 days (44.1%). Other substances used within the past 30 days include non-opioid pain medications ($n = 25$, 42.4%) and benzodiazepines ($n = 17$, 28.8%). The percentage of participants who were unaware of xylazine was similar between those who used stimulants and opioids in the past 30 days and those not currently using opioids (33.3% vs 38.5%, respectively). Table 1 overviews survey demographics by xylazine awareness. Table 2 overviews demographics of the purposive sample of interviewed survey participants who discussed xylazine.

The underdiscussed topic of xylazine and anecdotal knowledge

Qualitative data indicated limited awareness of xylazine in the regional drug supply, with most awareness derived from anecdotes or the media. For example, "Sean," a 30-year-old man who used crack cocaine but not opioids in the past 30 days, believed he had heard the name xylazine but was unable to share much about the substance: "*I think I've heard xylazine, but I'm not exactly sure what it is.*" Many recounted that they first heard about xylazine through television news and social media like "Jacqueline": "*On TV! I think it was—the city that it was happening in was—in California. I saw it, and I was like holy shit! It's crazy!*" (55-year-old woman, past 30-day crack cocaine use, no opioid use).

Participants who were only using stimulants at the time of participation who were generally aware of xylazine perceived xylazine as a seldomly discussed topic within their communities, illustrating how the drugs someone uses shapes conversations about the drug supply: *"I've never heard 'oh, we got tranq* [xylazine] *over here' or 'I know somebody who does tranq* [xylazine] *over there' or 'that guy is so messed up. He does tranq'. None of that.*" ["Anthony," 53-year-old man, past-30-day crack cocaine use, no opioid use]. Despite being the group most likely to have been exposed to xylazine by way of contaminated fentanyl, people who use stimulants and opioids felt that xylazine was rarely talked about, reflecting the modest but growing prevalence of xylazine in the drug supply at the time of data collection.

Speculating xylazine exposure through unanticipated use experiences

Seven of 59 survey participants believed that they had unintentionally bought or used drugs that they later found out or believed had xylazine ("tranq") in them (11.9%), of which all were participants who used stimulants and opioids in the past 30 days. These unexpected purchases occurred within the year prior to data collection, and one purchase occurred within the week prior to data collection. Six of these seven participants intended to purchase fentanyl/heroin and one participant was unsure which drug they used that they believed contained xylazine. Participants formulated retrospective connections between an unanticipated use experience and xylazine, whereby they recounted an unanticipated and undesired use experience (e.g., sedative effect of xylazine adulterated fentanyl) that occurred prior to learning about the potential for xylazine adulteration. Only after learning about xylazine did participants connect unexpected use experiences to xylazine.

Xylazine-associated wounds

Participants who were aware of xylazine commonly attributed the substance to the development of skin wounds. "Jaqueline," who used crack cocaine but not opioids in the past 30 days, shared that "*people had big ole holes in their… in… in… it*

Table 1. Characteristics of study participants by xylazine awareness ($N = 59$).

	Total		Aware of Xylazine		Unaware of xylazine	
	n	%	*n*	%	*n*	%
Socio-demographics			38	64.4	21	35.6
Age (years; mean [SD])	45.07	10.77	44.03	11.22	46.95	9.87
Sex						
Male	40	67.8	26	65.0	14	35.0
Female	19	32.2	12	63.2	7	36.8
Race*						
White, non-Hispanic	29	49.2	24	82.8	5	17.2
Black, non-Hispanic	14	23.7	7	50.00	7	50.0
Hispanic	12	20.3	5	41.7	7	58.3
Native American, non-Hispanic	2	3.4	0	0	2	100.0
Multiracial/ethnic	2	3.4	2	100	0	0
Educational Level*						
Some high school or less	16	27.1	6	37.5	10	62.5
High school graduate or GED equivalent	24	40.7	15	62.5	9	37.5
Some college or more	19	32.2	17	89.5	2	10.5
Housing status						
Living on the street	36	61	26	72.2	10	27.8
Temporary housing	18	30.5	9	50.0	9	50.0
In a house/apartment you own or rent	5	8.5	3	60.0	2	40.0
Past-30-Day Substance Use						
Stimulant and opioids	33	55.9	22	66.7	11	33.3
Stimulants, no opioids	26	44.1	16	61.5	10	38.5

SD: standard deviation. All *p* values derived from Chi-square test for categorical variables.
*p value < 0.05.

Table 2. Characteristics of interviewed participants who spoke about xylazine ($N = 18$).

Socio-demographics	Total	
	n	%
Age (years; mean [SD])	41.50	11.38
Sex		
Male	14	77.8
Female	4	22.2
Race*		
White, non-Hispanic	13	72.2
Black, non-Hispanic	2	11.1
Hispanic	2	11.1
Native American, non-Hispanic	–	–
Multiracial/ethnic	1	5.6
Educational Level*		
Some high school or less	3	16.7
High school graduate or GED equivalent	9	50
Some college or more	6	33.3
Housing status		
Living on the street	12	66.7
Temporary housing	6	33.3
In a house/apartment you own or rent	–	–
Past-30-Day Substance Use		
Stimulant and opioids	10	55.6
Stimulants, no opioids	8	44.4
Distributed drugs, past-12-months*	10	55.6
Has primary dealer ($n = 58$)	15	83.3

just eats away at your skin and flesh." Those with skin wounds cited the appearance of skin wounds as a primary reason why they believed they had unintentionally been exposed to xylazine. "Georgia," who used methamphetamine, crack cocaine, and opioids in the past 30 days, recollected:

> It [xylazine] was in one of the drugs I bought in Brockton here. I ended up with these bruises on my legs. A week later, I couldn't walk. The bruises had turned black… I had a month in the hospital, they chopped out all the dead skin and they said it was either chemical burn or road rash. I never used drugs in my legs. I only would use here [pointed to arms]. It took me forever to believe because it's only right above both knees where it settled and decided to—but, yeah. Xylazine's real. It's out here and it deteriorates your skin. I couldn't walk for three days. It was bad. Really bad. They found it in my tox-screen.

"Georgia's" experience is consistent with the onset of some xylazine wounds in that they progressed from what she described as "*bruises*" into black wounds that clustered together like *"road rash."* Black wounds signify the presence of eschar, and her wounds developed away from her injection sites—both of which are suggestive of xylazine involvement (Sue & Hawk, 2024). Additionally, "Georgia" reports that clinicians misdiagnosed her wounds and their cause as a "*chemical burn*" or "*road rash*" until toxicological assessment indicated xylazine involvement, suggesting that the clinicians who treated her may have had limited awareness of xylazine presence in the Brockton drug supply.

The knowledge that xylazine can cause wounds in areas other than injection sites and among those who do not inject was not shared by all participants. For example, one participant who used crack cocaine but did not use opioids recollected conversations with several people who do not inject drugs but who have wounds: "*I've seen a couple people who had like probably a serious boil, and I said 'well, do you shoot drugs?,' and they're like 'no,' and I go 'well then it's not an abscess'* [laughter]." ["Ralph," 52-year-old man]. Here, "Ralph", who only used stimulants, based his conclusion that these people's abscesses must not truly be abscesses if they were not preceded by injecting drugs, a reflection that he is unaware that the use of xylazine-containing drugs can produce skin wounds even among people who do not inject drugs.

"Sleepy-dope": xylazine-associated sedation

Interviewed participants characterized a xylazine-involved fentanyl high as lengthier and drowsier than what is typically experienced after using fentanyl that does not contain xylazine. "Brian" shared:

> Um, more of a drowsy—like not noddy where you nod off on heroin and you get a little itchy. It's more like it'll knock you out like for sleep, which isn't a characteristic of regular fentanyl that I use…This stuff could put you out for eight hours or so. We just call it just sleepy dope. [45-year-old man, used amphetamines, cocaine, crack cocaine, and opioids past 30 days].

Participants who themselves had experienced an atypical period of sedation suspected that xylazine had contaminated their fentanyl after hearing about how xylazine can cause somnolence. "Brian" continued:

> There's been a couple situations where I've done fentanyl where it's been a little different feeling in my body than normal. You know, with the news putting it [xylazine] in my head, I would just assume that it was something else, a tranquilizer or some kind of thing they put in there. So xylazine might be it.

Here, "Brian," like other interviewed participants, recollects having experienced an effect of fentanyl different from his usual high and linked this to xylazine after learning more about the adulterant.

Naloxone does not reverse xylazine sedation

Participants presumed xylazine was in a consumed drug if the use experience was associated with an overdose event in which naloxone alone was insufficient to address the overdose. "Nicholas," a 30-year-old man who used crack cocaine and opioids in the past 30 days, shared:

> If they get one with—has a lot of xylazine in it, and then a little bit of fentanyl, and that person goes out, like, you give them the Narcan and it takes the fentanyl, strips the fentanyl from the receptors, but it doesn't affect the tranquilizer. So, you think they're overdosing on fentanyl, give them the Narcan, and they still die, because it has no effect on it.

Clearly, "Nicholas" characterizes xylazine's involvement in overdose as life-threatening. He also cogently explains a belief shared among the interviewed participants who were aware of xylazine—naloxone does not reverse xylazine's sedative effect.

Xylazine is undesirable and avoided when possible

No participant expressed a desire to use xylazine, and participants, like "Marvin", who believed he had used xylazine,

Table 3. Additional quotes corresponding to each theme.

Themes and subthemes	Related quotes
The Underdiscussed Topic of Xylazine and Anecdotal Knowledge	"It's [xylazine] not talked about that much. Once in a blue moon." - "Jason", 32-year-old man, used crack cocaine, cocaine, and opioids past 30 days
	Interviewer: "Do you hear about xylazine from other folks around here or friends or anything like that?" "No. Xylazine? Never." - "Georgia", 33-year-old woman, used methamphetamine, crack cocaine, and opioids past 30 days
	"It's a thing where if someone's talking about it [xylazine], it's because they're trying to like let you know or let people know to stay away from it." - "Jason", 32-year-old man, used crack cocaine, cocaine, and opioids past 30 days
	Interviewer: "Are people around here talking about xylazine?" "Hell no! No, c'mon…hey, they're not worried about OD-ing and they do it all the time. They're not gonna worry about something that's eating their skin away." – "Jaqueline" – 55-year-old woman, used crack cocaine but not opioid use past 30 days
	"I've heard about other people, but no one close to me." – "Ralph", 62-year-old man, used crack cocaine but no opioid use past 30 days
Speculating Xylazine Exposure Through Unanticipated Use Experiences	"Somebody told me cause I have black outs sometimes that that might be the xylazine." – "Jesse", 49-year-old man, used amphetamines, crack cocaine, cocaine, and opioids past 30 days.
	I've heard that it's [xylazine] dangerous and it's been mixed with some of the other stuff instead of fentanyl. I don't really know much about it or I don't know that I've taken it. Or if I have, I didn't know it. But who knows? Maybe that could have been what I took the other night without even knowing it. Or when I lost that hour of time and I couldn't, you know, all the sudden, I snapped to, because I was thinking like I've done fentanyl and that's never happened. So maybe it wasn't fentanyl, I mean it could have been something else." - "Jason", 32-year-old man, used crack cocaine, cocaine, and opioids past 30 days
Xylazine-associated Wounds	"Dude was shooting up in his arm and got an abscess in his back." - "Derek", 34-year-old man, used crack cocaine and cocaine but no opioid use past 30 days
	"It [xylazine] eats your skin – eats you – like, eats your flesh from the inside out." – "Gregory', 31-year-old man, used crack cocaine but no opioid use past 30 days
	"It's [xylazine] been causing outbreaks of sores and stuff like that on people and myself included." – "Brett," 47-year-old man, used crack cocaine, cocaine, and opioids past 30 days
"Sleepy-dope": Xylazine-associated Sedation	"I've never seen anything like that until I came back to Brockton. I've been saying to myself that is a horse tranquilizer. I didn't know the name of it. [People were like] it's K, it's K. I'm like it's not special K. This is a horse tranquilizer. Ketamine will put you into a hole. This [referring to xylazine]—something's frozen." – "Michelle", 47-year-old woman, used crack cocaine but no opioid use past 30 days
	"When I do fentanyl I'll pass right out you know and that's not normal." – "Brett," 47-year-old man, used crack cocaine, cocaine, and opioids past 30 days
Naloxone Does Not Reverse Xylazine Sedation	"I just heard it's [xylazine], a new thing they're putting out there, putting in the fentanyl. It's not responding to uh what's the shit, Narcan… it's killing people." – "Marvin", 52-year-old man used amphetamines, crack cocaine, cocaine, and opioids past 30 days
	"It's [xylazine] something that they're putting in the fentanyl to make you—it's like it doesn't make you OD [overdose] fast or something like that. And it doesn't work on—Narcan doesn't work on it [xylazine]." – "Derek", 23-year-old man, used crack cocaine, cocaine, but no opioid use past 30 days
	"If you overdose you can't reverse it." – "Gregory', 31-year-old man, used crack cocaine but no opioid use past 30 days
	"The only way it [xylazine] really takes away from the high is just that [xylazine] knocks me out, and I'm not able to, you know, enjoy it. I'm sleeping." – "Brett," 47-year-old man, used stimulants and opioids past 30 days
Xylazine is Undesirable and Avoided When Possible	"I had to stay away from it [xylazine]. It's no good." – "Brian", 45-year-old man, used stimulant and opioids past 30 days
	"I haven't heard of anyone like oh 'I want that stuff [xylazine]!'" – "Jason", 32-year-old man, used stimulant and opioids past 30 days

hoped to never encounter it again: "*That's the bottom line. I'm not looking for it. I don't want it!*" (52-year-old man, used amphetamines, crack cocaine, cocaine, and opioids past 30 days). No participant described how they might avoid unintentionally consuming xylazine, which can be challenging to accomplish, as explained by "Jesse":

> I don't really got much option. When it's all said and done, I buy my drugs on the street, and I'm just gonna get what I get. You know, I try and deal with people that I trust and know, but then, you get what you get. ["Jesse," 49-year-old used amphetamines, crack cocaine, cocaine, and opioids past 30 days]

For additional exemplary quotes by theme, see Table 3.

Discussion

Our research extends the xylazine literature by examining xylazine awareness and concerns among a sample of people who all use stimulants, and in some cases, opioids like fentanyl as well—an important line of inquiry given that this population may be at risk of unintentional xylazine exposure by way of xylazine-adulterated fentanyl that has contaminated the stimulant supply (Martin et al., 2025; Streetcheck.org, 2025a; Wagner et al., 2023). There was fair-to-good awareness of xylazine in the drug supply, but awareness significantly differed by race and education level. Suspected unintentional exposure to xylazine was uncommon and occurred when participants had intended to purchase fentanyl. Additionally, participants experienced deleterious effects of xylazine, like skin wounds and unexpected sedation, and realized after the fact that xylazine was the likely cause of their untoward use experience. Amidst evolving regional variation in xylazine prevalence and calls for harm reduction strategies informed by PWUD (Kyei et al., 2024), our results indicate that harm reduction messaging about the potential presence of xylazine in the drug supply should be disseminated within communities of color and developed for PWUS following principles of health communication.

In the present sample of 59 PWUS, we found that approximately two-thirds (64%) of participants were aware of xylazine in the drug supply. Prior work has found variable levels of xylazine awareness among PWUD. Quijano et al. (2023) found that 68.5% of the Connecticut-based participants surveyed from April 2021 to July 2022 were aware of xylazine. Data collected in the same period of time as our data from Lowell, Massachusetts, an overdose hotspot and HIV-outbreak-affected community approximately 50 miles from Brockton, Massachusetts, found that 50% of PWUD (~43% used cocaine daily) were aware of xylazine (Rapisarda et al., 2025; Shrestha et al., 2025). Similarly, in their 2023 data with PWUD in Rhode Island, of which 92% used a stimulant in the past six months, Park et al. (2024) found that 50% of PWUD were aware of xylazine. Others have found lower awareness of xylazine (45%) among those in 78 US-based substance use treatment programs in 2023 (Hochheimer et al., 2024). Differing levels of xylazine awareness across different drug markets are unsurprising and indicate that continued efforts to communicate about the risk of adulterants, such as xylazine, in the drug supply are needed to increase awareness levels.

We observed noteworthy quantitative differences in xylazine awareness by race. Compared to White non-Hispanic participants, more Hispanic, Black non-Hispanic, and Native American non-Hispanic participants were unaware of xylazine in the drug supply. Prior research has also found racial differences in xylazine awareness, with White (Hochheimer et al., 2024) and White Hispanic people more likely to be aware of xylazine relative to other racial groups (Quijano et al., 2023). Limited awareness of xylazine in the drug supply could result in unintentional exposure to xylazine, potentially exacerbating the xylazine-involved overdose mortality rates among communities of color, and in particular Black decedents relative to other races (Zhu & Cano, 2025). Our finding that communities of color are less aware of xylazine than White participants reflects the historical exclusion from and mistreatment of people of color within healthcare systems and social services, leading to mistrust and reduced engagement with health systems where people are exposed to health-protective information (Hughes et al., 2022). Grassroots harm reduction campaigns by and for communities of color to promote harm reduction strategies should be updated and disseminated in the era of xylazine (Hughes et al., 2022; Owczarzak et al., 2020). To that end, community engaged co-design approaches with PWUD that are adaptive to group feedback, iterative, and reflexive should be pursued to create salient harm reduction messages (Hussey et al., 2019).

Participants with less education in our study were more likely to be unaware of xylazine than those with more education, which has been observed with PWUD in other communities including Lowell, Massachusetts (Shrestha et al., 2025). Existing harm reduction materials about xylazine may be inaccessible to those with less education. Accordingly, it would be most effective if all harm reduction messaging about xylazine were authored at an eighth-grade literacy level or below and utilized visual aids (e.g., of skin wounds on diverse skin pigmentations) to convey safer-use messaging (European Monitoring Centre for Drugs and Drug Addiction, 2023). Following co-design principles (Slattery et al., 2020), these messages should be co-created with PWUD, including those who use stimulants and people of color, and should utilize community language including specific terms for xylazine, to acknowledge and validate lived experiences. Messages should be concept-tested with the target audience and evaluated to determine whether xylazine harm reduction messages influence the uptake of harm reduction strategies to reduce exposure to and mitigate the impact of xylazine.

The percentage of participants who used stimulants and opioids in the past 30 days who were aware of xylazine was slightly greater than the percentage of participants who were not using opioids and were aware of xylazine (66.7%, $n = 22$ vs 61.5, $n = 16$, respectively). This trend is consistent with extant work examining xylazine awareness by drug use (Quijano et al., 2023). We may not have observed greater awareness of xylazine among those using opioids because xylazine was only appearing sporadically in the unregulated fentanyl supply in Brockton during our data collection period (Streetcheck.org, 2025a). People congregate outside of the community organization we collaborated with, and in doing so, may have naturally engaged in conversations about the drugs they and others in the community were using, which could explain comparable levels of xylazine awareness regardless of substance use history. However, our qualitative results suggest that not all participants are having conversations about xylazine and that people who are not using opioids are less knowledgeable about xylazine aside from some exposure to xylazine-specific media coverage. When disseminating information about the risk of xylazine in the drug supply, harm reduction organizations and clinicians should be cautious about framing exposure risk solely as a fentanyl-related issue. PWUS may also be at risk of unintentional xylazine exposure but may not perceive themselves to be at risk if messaging focuses only on people using fentanyl.

Few participants in this research believed that they had unintentionally purchased drugs containing xylazine ($n = 7$, 11.9%), which aligns with drug checking data showing that 15% (6/39) of fentanyl samples in Plymouth County, Massachusetts contained xylazine in 2023 (Streetcheck.org, 2025a). It is notable suspected xylazine exposure occurred in people who used both stimulants and opioids. In our sample of PWUS, no participant reported intentionally combining xylazine with stimulants, a use pattern that characterized some of the earliest reported human use of xylazine in Puerto Rico, where the adulterant was primarily used in combinations of heroin and cocaine (i.e., a speedball) (Reyes et al., 2012; Rodríguez et al., 2008). More recently, research among people exposed to xylazine in Miami, Florida—a city in which xylazine is prevalent in the drug supply (Hauschild et al., 2023)—reported having increased their use of stimulants to combat xylazine's sedative effect and others have done so to protect themselves from the risk of assault due to somnolence (Eger et al., 2024). As stimulants and opioid co-use increases, healthcare settings that primarily serve PWUS are well-positioned to help characterize how xylazine

adulterated fentanyl affects stimulant use patterns, especially because xylazine's presence in stimulants could compound the health challenges already faced by people using multiple substances.

Xylazine-associated wounds and somnolence were identified as indicators of xylazine exposure. Participants who were using only stimulants were unaware that wounds may appear in places other than injection sites and among people who do not inject drugs (Sue & Hawk, 2024). This suggests that those who consume stimulants in ways other than injection may not perceive themselves to be at risk of xylazine-associated wounds. Accordingly, risk communication messaging about xylazine for PWUS should clarify that xylazine-associated wounds can occur without injection. Simulation studies have found that smoking (i.e., heating) xylazine produces ingestible vapors (The Massachusetts Drug Supply Data Stream, n.d.), and people who snort or smoke xylazine-adulterated fentanyl have reported nasal cavity wounds (Reed et al., 2025). What remains to be understood is if smoking xylazine confers the same level of exposure and risk of wound development when ingested or injected—an important line of inquiry that could have harm reduction and clinical implications. Although not explored in the present research, it remains to be understood whether skin picking and scratching, behaviors that can occur among people using stimulants, are associated with an increased risk of developing xylazine-associated wounds among PWUS exposed to xylazine. Participants aware of xylazine also shared that xylazine has changed the way that fentanyl highs are experienced by making them lengthier and drowsier, as has also been described by PWUD in Lowell, Massachusetts (Shrestha et al., 2025). Despite identifying that naloxone alone is insufficient to respond to a xylazine adulterated fentanyl overdose, no participant identified respiratory support an important component of responding to a xylazine-involved overdose (Bufanda et al., 2025; Quijano et al., 2023; Reed et al., 2025). Existing opioid overdose response trainings should underscore the role of rescue breaths in the era of xylazine and emphasize that PWUS may be at risk of unintentional exposure to xylazine by way of xylazine-adulterated fentanyl contaminating the simulant supply.

The PWUS in this study reported that they did not want to use xylazine, which has been previously documented among PWUD (Eger et al., 2024; Hochheimer et al., 2024; Park et al., 2024; Reed et al., 2022, 2025). New England drug checking data suggests that xylazine is avoidable in the drug supply (Collins et al., 2023; Park et al., 2024; Streetcheck.org, 2025b). To that end, community-based drug checking services that are located within syringe services programs should be expanded and promoted to PWUS (Moon et al., 2024), as this service affords a timely understanding of the drug supply, thereby empowering PWUS to make informed decisions about their use (T. C. Green et al., 2022). Additionally, training and technical assistance programs developed to train clinicians to screen for and treat xylazine exposure should make clear that xylazine may affect the health of people who primarily or only use stimulants in addition to those who primarily use fentanyl (Jawa et al., 2024).

Limitations

This study is not without limitations. First, while the purposive sampling approach of the parent study was appropriate for the present analysis, it considered multiple factors beyond xylazine awareness. As a result, three of 21 interviewed participants did not discuss xylazine, yielding an analytic sample of 18 transcripts. This also meant that the views of people who are xylazine-unaware, which our quantitative findings demonstrate consist of more people of color and those with some high school education or less, were insufficiently explored qualitatively; this represents an important line of future inquiry because tailored harm reduction messages for communities of color and those with less education will be most salient if the voices of these communities are centered when creating these materials. Second, it was a missed opportunity to not assess interest in the use of xylazine test strips among a sample of PWUS. Future researchers would do well to assess interest in and use of xylazine test strips. Third, quantitative findings need to be replicated in larger samples and in different drug markets to understand whether the observed differences in xylazine awareness by race and education level persist. Relatedly, xylazine's presence in the drug supply varies considerably across the US (Cano et al., 2024; Friedman et al., 2022). The qualitative findings and implications of this research are most transferable to communities in which xylazine's prevalence is growing, particularly in the stimulant supply. Fourth, though the decision to use past-30-day opioid use as a proxy for xylazine exposure was the best available way to approximate xylazine exposure based on the available data, this approach may not accurately represent exposure risk and could have resulted in the misclassification of participants; future xylazine focused research should consider utilizing community drug checking to enroll participants whose drug supply is adulterated with xylazine.

Conclusion

Amidst a rise in polysubstance use and contamination of the unregulated drug supply, this study explored awareness of xylazine among PWUS, an overlooked population in xylazine research despite the potential for xylazine to appear in the stimulant drug supply. We found that there was moderate awareness of xylazine, consistent with what would be expected in the context of the Brockton, Massachusetts drug supply at the time of data collection. A greater percentage of people of color and those with a high school education or less were unaware of xylazine. This underscores that PWUS need tailored messaging focusing on stimulants and the risks associated with fentanyl and xylazine. Harm reduction messaging should be developed with those with lived experience, using accessible language, and delivered by trusted messengers, especially among communities of color. Increasing access to drug checking technologies is also essential, as participants suspected xylazine exposure only after unexpected use experiences.

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Authors contributions

JMWH, TCG, and JDR conceptualized the study and acquired funding. PJAK curated and analyzed the data, interpreted the findings, and wrote and edited the manuscript. SAV was responsible for project administration. All authors helped to interpret the findings, reviewed and edited the manuscript, and approved the final manuscript.

Declaration of interest

The authors report no conflict of interest.

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Data availability statement

The data that support the findings of this study are available from the senior author upon reasonable request.

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