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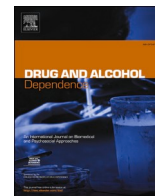
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## Prevalence and correlates of stocking up on drugs during the COVID-19 pandemic: Data from the C3PNO Consortium

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### ABSTRACT

**Background:** Data from the COVID-19 pandemic describes increases in drug use and related harms, especially fatal overdose. However, evidence is needed to better understand the pathways from pandemic-related factors to substance use behaviours. Thus, we investigated stockpiling drugs among people who use drugs (PWUD) in five cities in the United States and Canada.

**Methods:** We used data from two waves of interviews among participants in nine prospective cohorts to estimate the prevalence and correlates of stockpiling drugs in the previous month. Longitudinal correlates were identified using bivariate and multivariate generalized linear mixed-effects modeling analyses.

**Results:** From May 2020 to February 2021, we recruited 1873 individuals who completed 2242 interviews, of whom 217 (11.6%) reported stockpiling drugs in the last month at baseline. In the multivariate model, stockpiling drugs was significantly and positively associated with reporting being greatly impacted by COVID-19 (Adjusted Odds Ratio [AOR]= 1.21, 95% CI: 1.09–1.45), and at least daily use of methamphetamine (AOR = 4.67, 95% CI: 2.75–7.94) in the past month.

**Conclusions:** We observed that approximately one-in-ten participants reported stocking up on drugs during the COVID-19 pandemic. This behaviour was associated with important drug-related risk factors including high-intensity methamphetamine use. While these correlations need further inquiry, it is possible that addressing the impact of COVID-19 on vulnerable PWUD could help limit drug stockpiling, which may lower rates of high-intensity stimulant use.

### 1. Introduction

The novel coronavirus disease 2019 (COVID-19) pandemic continues to severely impact people around the world, including people who use

drugs (PWUD). Many PWUD have risk factors for infection and severe illness and death from COVID-19 (Vasyljeva et al., 2020; Dunlop et al., 2020; Stowe et al., 2020), including experiencing barriers to following quarantine and social distancing guidelines, living in unsanitary

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conditions, poor hygiene, and an elevated prevalence of underlying co-morbid conditions (Vasylyeva et al., 2020). At the same time, many settings in the United States and Canada have seen an unprecedented increase in the numbers of fatal overdoses since the onset of the pandemic (British Columbia Center for Disease Control, 2021; Centers for Disease Control and Prevention, 2022). While the reason for this large spike in overdose rates is not fully known, it has been theorized that it is a result of many intersecting factors, including the inability to use drugs with peers to perform drug spotting (i.e., using with a peer who can respond to an overdose), changes to drug purity and composition as a result of disruptions to drug markets, and the reduced capacity of harm reduction sites (British Columbia Center for Disease Control, 2020; Dietze and Peacock, 2020).

Stockpiling drugs is one understudied behaviour hypothesized to be associated with elevated overdose risk. Previous research prior to the COVID-19 pandemic observed that stockpiling of drugs and paraphernalia was associated with higher-risk drug use, more frequent drug use, and periods of reduced drug quality (McCormack et al., 2016; Langfield et al., 2021). Moreover, all three of these factors are associated with increased rates of overdose, which could help to explain the potential association between stockpiling of drugs during the pandemic, and the recent increase in overdose rates (Dowell et al., 2017; Latkin et al., 2018; Darke & Hall, 2003).

Given the immense burden that the COVID-19 pandemic and the overdose crisis have placed on PWUD in the United States and Canada, there is an urgent need to identify links between these dual-health threats that can be addressed with harm reduction services, treatment strategies, and other approaches. Although population-level data describes increases in substance use and related harms, especially overdose, during the COVID-19 pandemic, the reasons for these changes are unclear. Consequently, this paper aims to investigate stockpiling drugs among PWUD participating in nine cohort studies in five cities in the United States and Canada.

## 2. Methods

This study used data collected under the auspices of the Collaborating Consortium of Cohorts Producing National Institute on Drug Abuse (NIDA) Opportunities (C3PNO), which was established in 2017 by the United States National Institutes of Health's NIDA to enhance data sharing opportunities and mechanisms to facilitate collaborative research efforts among NIDA-funded cohorts that examine HIV in the context of substance use. The consortium is comprised of nine prospective cohorts in four cities in the United States and one in Canada: Baltimore, MD; Miami, FL; Chicago, IL; Los Angeles, CA; and Vancouver, Canada. These studies have a combined size of approximately 12,000 participants. The cohorts include: the Vancouver Injection Drug Users Study (VIDUS: Vancouver, Canada, HIV-negative people who inject drugs [PWID]); the AIDS Care Cohort to Evaluate exposure to Survival Services (ACCESS: Vancouver, Canada, HIV-positive PWUD); the At-Risk Youth Study (ARYS: Vancouver, Canada, at-risk young PWUD); the AIDS Linked to the IntraVenous Experience (ALIVE: Baltimore, Maryland, PWID); the Healthy Young Men's Study (HYM: Los Angeles, California, young men who have sex with men [MSM]); the Johns Hopkins HIV Clinical Cohort (JHCC: Baltimore, Maryland, people living with HIV); the Miami Adult Studies on HIV (MASH: Miami, Florida, focused on cocaine use, HIV, and hepatitis C virus); mSTUDY (Los Angeles, California, African American or Hispanic MSM); the Multilevel Influences on HIV and Substance Use in young MSM Cohort (RADAR: Chicago, Illinois, young MSM), and the Hopkins Heart Study (HEART: Baltimore, Maryland, African American individuals to study the effects of HIV, cocaine, and prolonged antiretroviral therapy use on subclinical cardiovascular disease). Further details of the participating cohorts have been previously described (Gorbach et al., 2021). The participating cohorts and their consortium activities have been reviewed and approved by the relevant research ethics boards. (Gorbach et al., 2021).

Between May 2020 and February 2021, the cohorts recruited a subset of participants to respond to a survey about their experiences during the COVID-19 pandemic. The survey included questions on the impact of COVID-19, use of harm reduction and HIV-related services, changes in substance use patterns, as well as various measures of mental and physical health status. The studies conducted two waves of interviews between May 11, 2020, and February 15, 2021. For the current analysis, we included all interviews in which the participant reported any drug use in the last month.

We defined the primary outcome of interest to be stocking up on drugs in the last month (yes vs. no), which was determined by asking the participant if they endorsed the statement: "In the last month because of the COVID pandemic I have stocked up on drugs."

We included a range of explanatory variables as hypothesized correlates of stocking up on drugs, including demographic characteristics, social/structural exposures, substance use-related behaviours, and the impacts of COVID-19. These were: age (continuous, per year older); sex (male vs. female, gender diverse inclusive; this category included participants who identify as transgender, Two-Spirit, and those who preferred to self-describe in an 'other' category); ethnicity (White vs. other); housing status (living in a house/apartment vs. other); non-fatal overdose, defined as an acute negative reaction following drug use (yes vs. no); being on medications for opioid use disorder (MOUD) (yes vs. no); daily alcohol use (yes vs. no); daily methamphetamine use (yes vs. no); daily heroin use (yes vs. no); daily fentanyl use (i.e., from the unregulated market, yes vs. no); daily cocaine use (yes vs. no); daily non-medical prescription opioid (PO) use, defined as taking POs that were not prescribed or taking POs only for the experience or feeling they caused, other than fentanyl (yes vs. no); and HIV serostatus (positive vs. negative). COVID-19-related variables were: worry about COVID-19 (integers from 0 to 10, with zero representing no worry); impact of COVID-19 on daily functioning (integers from 0 to 5, with zero representing no impact); previous COVID-19 testing (yes vs. no); not using MOUD sites in the last month (yes vs. no); and not using needle exchange programme (NEP) sites in the last month (yes vs. no). All behavioural variables referred to the period beginning one month prior to each interview.

First, we stratified each explanatory variable described above by the outcome (i.e., stocking up on drugs in the last month) at baseline to examine their distributions. The Mann-Whitney U test was employed for continuous variables while binary variables were analyzed through Pearson's Chi-squared test. Next, bivariable and multivariable relationships between each explanatory variable and stockpiling drugs were analyzed through a generalized linear mixed models (GLMM) incorporating participant ID and cohort. The bivariate model used the GLMM with the logit link function and the multivariable model incorporated covariates significantly associated with the outcome of interest in the bivariate model ( $p < 0.05$ ). The model included terms for study site (i.e., Vancouver vs. Los Angeles vs. Chicago vs. Miami vs. Baltimore) and a unique ID for each study participants as clustering factors for random effects. All p-values were two-sided.

## 3. Results

We included 2449 (50.2%) interviews from 1873 participants in these analyses. We excluded 2321 (47.6%) interviews that did not include a report of any drug use within the last month as well as 106 (2.2%) other interviews that were missing data from covariates that were incorporated into the statistical model.

Table 1 reports the baseline characteristics of the study sample. The median age at baseline was 35 years. The majority of participants self-identified themselves as White (67.2%) and male sex (75.3%). More than three-quarters of participants (77.4%) reported having secure housing and 35.1% of participants were HIV-positive at the time of the survey.

Overall, 217 participants (11.6%) reported stocking up on drugs in

**Table 1**  
Baseline characteristics of 1873 drug-using participants, stratified by stocking up on drugs in the last month in five major cities in the United States and Canada.

	Total n (%)	Stockpiling Drugs <sup>b</sup>		p-value
		Yes n = 217 (10.4%)	No n = 1656 (89.6%)	
<b>Socio-demographics</b>				
Age (median, IQR)	35 (26–52)	38 (27–51)	34 (26–52)	0.208 <sup>a</sup>
Male sex	1410 (75.28)	152 (70.05)	1258 (75.97)	0.003
White ethnicity	1259 (67.22)	147 (67.74)	1112 (67.15)	0.473
<b>Study setting</b>				
Vancouver, Canada	646 (34.49)	100 (46.08)	546 (32.97)	0.002
Baltimore, MD	296 (15.80)	26 (11.98)	270 (16.30)	
Chicago, IL	290 (15.48)	22 (10.14)	268 (16.18)	
Los Angeles, CA	507 (27.07)	51 (23.50)	456 (27.54)	
Miami, FL	134 (7.15)	18 (8.29)	116 (7.00)	
<b>Study cohort</b>				
ACCESS	175 (9.34)	30 (13.82)	145 (8.76)	< 0.001
ALIVE	162 (8.65)	17 (7.83)	145 (8.76)	
ARYS	223 (11.91)	28 (12.90)	195 (11.78)	
HEART	36 (1.92)	1 (0.46)	35 (2.11)	
HYM	251 (13.40)	18 (8.29)	233 (14.07)	
JHHCC	98 (5.23)	8 (3.69)	90 (5.43)	
MASH	134 (7.15)	18 (8.29)	233 (14.07)	
MSTUDY	256 (13.67)	33 (15.21)	223 (13.47)	
RADAR	290 (15.48)	22 (10.14)	268 (16.18)	
VIDUS2	248 (13.24)	42 (19.34)	206 (12.44)	
<b>Socio-Structural</b>				
Secure housing <sup>b</sup>	1449 (77.36)	145 (66.82)	1304 (78.74)	< 0.001
<b>Clinical</b>				
HIV-positive	658 (35.13)	72 (33.18)	586 (35.39)	0.546
<b>COVID-19</b>				
COVID worry (median, IQR)	7 (4–8)	7 (4–8)	7 (4–8)	0.233 <sup>a</sup>
COVID impact (median, IQR)	4 (2–5)	4 (2–5)	4 (2–5)	0.002 <sup>a</sup>
Not using NEP <sup>b</sup>	127 (6.78)	23 (10.60)	104 (6.28)	0.022
Not using MOUD <sup>b</sup>	65 (3.47)	10 (4.61)	55 (3.32)	0.323
COVID tested ever	1309 (69.89)	135 (62.21)	1174 (70.89)	0.012
<b>Substance use</b>				
Non-fatal overdose <sup>b</sup>	46 (2.46)	8 (3.69)	38 (2.29)	0.238
MOUD use <sup>b</sup>	301 (16.07)	41 (18.89)	260 (15.70)	0.238
Daily alcohol use <sup>b</sup>	144 (7.69)	21 (9.68)	123 (7.43)	0.277
Daily methamphetamine use <sup>b</sup>	167 (8.92)	55 (25.35)	112 (6.76)	< 0.001
Daily heroin use <sup>b</sup>	57 (3.04)	15 (6.91)	42 (2.54)	0.002
Daily fentanyl use <sup>b</sup>	80 (4.27)	22 (10.14)	58 (3.50)	< 0.001
Daily cocaine use <sup>b</sup>	26 (1.39)	7 (3.23)	19 (1.15)	0.024
Daily prescription opioid use <sup>b</sup>	45 (2.40)	5 (2.30)	40 (2.42)	1.000

Note: 95% CI: 95% Confidence interval; IQR: Interquartile range; NEP: Needle exchange programs; MOUD: Medications for opioid use disorder

<sup>a</sup> Mann-Whitney U test used for continuous variables; all other p-values employed Chi-squared test

<sup>b</sup> Refers to one month period prior to study interview

the last month at baseline. Notably, the prevalence of stocking up was higher among individuals in Vancouver, Canada compared to each of the study settings based in cities in the USA (15.5% in Vancouver sites). Regarding COVID-19, the median response for the COVID-19 worry scale (a 10-point scale pertaining to fear and worry about COVID-19) was seven and the median response for the COVID-19 impact scale (a five-point scale measuring COVID-19 impact) was four. Additionally, 69.9% of participants had ever been tested for COVID-19 at the time of the survey.

Table 2 presents the bivariable and multivariable GLMM estimates of the relationships between the explanatory variables and stocking up on drugs in the last month. In unadjusted analyses, reporting a greater impact from COVID-19 (Odds Ratio [OR] = 1.27 per point, 95% CI: 1.26–1.28), not using needle exchange programs (NEP, OR = 3.64, 95% CI: 1.35–9.85), not using medications for opioid use disorder (MOUD, OR = 4.63, 95% CI: 1.26–16.99), daily use of methamphetamine (OR =

**Table 2**  
Bivariable and multivariable GLMM analysis of factors associated with stocking up on drugs in the last month in 2449 interviews from 1873 participants in five cities in the United States and Canada.

Characteristic	Odds Ratio (95% CI)	Stockpiling Drugs		
		p-value	Adjusted Odds Ratio (95% CI)	p-value
<b>Socio-demographics</b>				
Age (per year older)	1.00 (0.97–1.03)	0.820		
Male sex	0.59 (0.22–1.62)	0.307		
White ethnicity	1.04 (0.39–2.74)	0.938		
<b>Social/structural</b>				
Secure housing	0.43 (0.18–1.04)	0.062		
<b>Clinical</b>				
HIV-positive	0.88 (0.35–2.23)	0.795		
<b>COVID-19</b>				
COVID worry (per point)	1.12 (0.97–1.28)	0.116		
COVID impact (per point)	1.27 (1.26–1.28)	< 0.001	1.21 (1.09–1.35)	< 0.001
Not using NEP	3.64 (1.35–9.85)	0.011	1.65 (0.96–2.85)	0.071
Not using MOUD	4.63 (1.26–16.99)	0.021	1.11 (0.52–2.38)	0.785
COVID tested ever	0.51 (0.22–1.18)	0.114		
<b>Substance use</b>				
Non-fatal overdose	1.82 (0.24–13.75)	0.560		
MOUD use	2.39 (0.92–6.24)	0.074		
Daily alcohol use	0.78 (0.17–3.64)	0.751		
Daily MA use	4.40 (1.50–12.91)	0.007	3.86 (2.57–5.82)	< 0.001
Daily heroin use	3.00 (0.45–19.97)	0.257		
Daily fentanyl use	3.43 (0.74–15.91)	0.115		
Daily cocaine use	4.05 (0.48–34.55)	0.201		
Daily presc. opioid use	0.02 (0.00–8.67)	0.205		
<b>Other</b>				
Weeks since COVID start	0.97 (0.97–0.97)	< 0.001	0.99 (0.98–1.00)	0.249

Note: 95% CI: 95% Confidence interval; IQR: Interquartile range; NEP: Needle exchange programs; MOUD: Medications for opioid use disorder; GLMM: generalized linear mixed-effects model; MA: methamphetamine

4.40, 95% CI: 1.50–12.91), and the number of weeks since the start of the COVID pandemic (OR = 0.97, 95% CI: 0.97–0.97) had greater odds of stockpiling drugs. In the multivariable model, daily use of methamphetamine (AOR = 4.67, 95%CI: 2.75–7.94) and self-reporting greater COVID impact (AOR = 1.21, 95% CI: 1.09–1.35) were significantly associated with greater odds of stockpiling.

#### 4. Discussion

In this multi-site study of PWUD, we observed that more than one-in-ten participants reported stocking up on drugs as a result of the COVID-19 pandemic in the last month at baseline. Notably, the prevalence of this behaviour at the baseline interview varied significantly by study setting with approximately 15% of participants reporting stockpiling in Vancouver, Canada, compared to less than 8% in Miami, Florida. In a longitudinal statistical model, this behaviour was more common among periods in which participants self-reported being more impacted by the pandemic and high-intensity methamphetamine use.

Three reports from Australia have documented similar levels of stockpiling drugs during the COVID-19 pandemic (Daly et al., 2020; Dietze and Peacock, 2020; Peacock et al., 2021). In a study from the Ecstasy and Related Drugs Reporting System, a drug monitoring system operating in Australia since 2003, 7 of 100 participants interviewed during the COVID-19 pandemic reported buying drugs in bulk for themselves (Daly et al., 2020). This strategy, which may be employed to help individuals avoid drug withdrawal during anticipated shortages in drugs available in the market, is dependent on drug availability and individuals having the financial ability to buy in bulk, and could increase the risks of overdose and enhance criminal penalties for drug possession (Dietze and Peacock, 2020; International Network of People who use Drugs, 2020). However, having the financial means to stock up on drugs could also make daily drug use more feasible, thus potentially suggesting a spurious relationship between stocking up on drugs and daily drug use.

We observed that the odds of high-intensity (i.e., daily) use of methamphetamine were approximately 4.5 greater during periods of drug stockpiling during the COVID-19 pandemic. Other research during the pandemic has highlighted sharp reductions in the supply and concomitant increase in the cost of amphetamines and other stimulants worldwide during the pandemic, perhaps contributing to individuals buying in bulk to reduce per-unit costs (Farhoudian et al., 2020; Di Trana et al., 2020). In addition, methamphetamine is highly addictive (Petit et al., 2012; Nestler, 2004) with a short half-life (Cone, 1995; Barnett et al., 1981). Together, this points to the fact that having a steady supply of methamphetamine is essential for those who use regularly or live with methamphetamine use disorder.

Studies among the general population and people living with substance use disorders have both noted increases in substance use during the pandemic, possibly as a reaction to increased stress and anxiety or to cope with social isolation (Dietze and Peacock, 2020; Pollard et al., 2020). These stressors might be particularly acute among members of marginalized groups, such as PWUD who lack the social and financial capital to buffer pandemic-related disruptions (Shevlin et al., 2020; Vasylyeva et al., 2020). Moreover, withdrawal symptoms from drug use, especially stimulant drug use, can place further stress, anxiety, and discomfort on PWUD (Chartoff and Carlezon Jr, 2014; Grunberg et al., 2011). Taken together, this provides a hypothesis for the association between stocking up on drugs and being impacted by COVID-19.

This study has limitations to be considered. First, the C3PNO cohorts were not recruited via random sampling and should not be considered representative of the broader population of PWUD in these cities or across the United States and Canada. Second, the burden of the COVID-19 pandemic differed between the cohort sites and the time of survey administration. Accordingly, surveys completed at the beginning of the pandemic could potentially vary from surveys completed later in the pandemic. It is important to also highlight that the definition of the

outcome of interest, stocking up on drugs in the last month, likely differed between participants, meaning subjective stockpiling behaviours (i.e., amount of substances that participants stocked up on) likely differed among participants. Additionally, the data used is self-reported, which may result in under- or over-reporting of behaviours included in the models, especially those that are socially stigmatised or legally prohibited. Finally, it is important to emphasize that the results presented in this study arise from observational correlational analyses and further investigation is required to determine if the relationships are causal.

#### 5. Conclusions

In conclusion, we observed approximately one-in-ten participants stocked up on drugs during the COVID-19 pandemic, a behaviour linked to not using NEP, being greatly impacted by COVID-19, and daily cocaine and methamphetamine use. Our findings illustrate how marginalized PWUD have been impacted by the COVID-19 pandemic. Further, they underline the need for public health officials to consider strategies to address drug-related harms arising as a result of the COVID-19 pandemic or mitigation strategies.

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#### Contributors

KD, KH, PMG, MJM and BG conceived the study question; KD, KH, PMG, MJM, GK, SHM, MK, RDM, MKB, SS, PMG, & BM designed the study questionnaire, implemented the study, and oversaw data collection; JC, MJ, & SS designed and managed consortium databases and data integration; MJM, BG, and LK designed the analytic approach; JC, MJM, and MJ performed data analyses; LK, MJM, BG, KD, KH, GK, and SHM reviewed data outputs and approved final analyses; LK drafted the manuscript; LK, MJM and BG revised the manuscript; all other authors reviewed the manuscript. All authors approved the final submitted version.

#### Disclosures

M-JM holds the Canopy Growth professorship in cannabis science at the University of British Columbia, a position established through arm's length gifts to the university from Canopy Growth, a licensed producer of cannabis, and the Government of British Columbia's Ministry of Mental Health and Addictions. He has no financial relationships with the cannabis industry. The VIDUS2 and ARYS studies are funded by the United States National Institute on Drug Abuse (NIDA, U01DA038886). The ACCESS study is funded by NIDA (U01DA0251525). M-JM is supported by salary awards from the Canadian Institutes of Health Research (CIHR) and the Michael Smith Foundation for Health Research.

#### Conflicts of interest

M-JM holds the Canopy Growth professorship in cannabis science at the University of British Columbia, a position established through arm's length gifts to the university from Canopy Growth, a licensed producer of cannabis, and the Government of British Columbia's Ministry of Mental Health and Addictions. He has no financial relationships with the cannabis industry.

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