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**Title**

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# Food insecurity during the COVID-19 pandemic who use drugs in Vancouver, Canada

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## Abstract

*Objective:* To examine prevalence and factors associated with food insecurity among people who use drugs (PWUD) during the first year of the COVID-19 pandemic and the overdose crisis.

*Design:* This cross-sectional study employs multivariable logistic regression to identify factors associated with self-reported food insecurity.

*Participants:* PWUD who are part of three community-recruited cohorts.

*Setting:* Interviews conducted in Vancouver, Canada, via phone between July and November 2020 in adherence to COVID-19 safety procedures.

*Results:* Among 765 participants, including 433 (56·6 %) men, eligible for this study, 146 (19·1 %; 95 % CI: 16·3 %, 21·9 %) reported food insecurity in the past month. Of the participants reporting food insecurity, 114 (78·1 %) reported that their hunger levels had increased since the beginning of the pandemic. In multivariable analyses, factors independently and positively associated with food insecurity included: difficulty accessing health or social services (adjusted OR (AOR) = 2·59; 95 % CI: 1·60, 4·17); having mobility difficulties (AOR = 1·59; 95 % CI: 1·02, 2·45) and engaging in street-based income generation (e.g. panhandling and informal recycling) (AOR = 2·31; 95 % CI: 1·45, 3·65).

*Conclusion:* Approximately one in five PWUD reported food insecurity during this time. PWUD with mobility issues, who experienced difficulty accessing services and/or those engaged in precarious street-based income generation were more likely to report food insecurity. Food security is paramount to the success of interventions to prevent COVID-19 and drug toxicity deaths. These findings suggest a need for a more unified state response to food insecurity that prioritises and incorporates accessibility and autonomy of the communities they serve.

There is a broad international consensus that food (in) security and nutrition can be understood as social determinants of health[1,2]. The Food and Agriculture Organization of the United Nations (FAO) defines food access as the ability 'by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live'[3]. The FAO definition of food security, similar to other institutional bodies and the Canadian federal government, includes the broader socio-economic context of access to adequate foods[3–5]. Several international organisations, including the FAO and the WHO, estimate that two billion people 'did not have regular access to safe, nutritious and sufficient food'[6] in 2019 and that disruptions caused by the COVID-19 pandemic would see another 83–132 million people added to that total temporarily[6]. Emerging international research shows that the crisis context of the COVID-19 pandemic may have impacted food procurement and waste strategies[7].

Food insecurity has been associated with physical and mental health issues among people who use drugs (PWUD), including a higher likelihood of depression in

youth[8] and lowered mortality rates for those who are living with HIV[9]. Socio-economic marginalisation, including food insecurity, has been linked with greater risks of opioid-related overdose[10]. There is also evidence portraying food insecurity as a factor involved in increased opioid use, and one Canadian study showed a strong link between food insecurity, chronic pain and prescription opioid use[11].

In Vancouver, Canada, charitable food services are concentrated in a few neighbourhoods[12], especially the Downtown Eastside (DTES) neighbourhood, an area with prevalent marginalisation and criminalisation of residents. In the DTES, food insecurity is a complex matter. There is a network of free and subsidised food services within the neighbourhood; however, regulations and accessibility of these services vary greatly[12]. For instance, many food services require people to stand in lines for an extended period of time, which can be a barrier, particularly for people with disabilities, mobility issues and/or those who engage in daily substance use[13]. In 2005, a report commissioned by the Vancouver's municipal government recommended that community organisations end the practice of line-ups[12]. Notably, the report recommended that frontline staff should increase their respect of people who utilise food services[12]. The patchwork of services gives significant discretion to various service providers, mostly non-profit organisations and charities, to refuse to serve people based on behaviours or appearances they may dislike (including gender, health status, etc.)[12]. The COVID-19 pandemic further complicated the DTES food network with service closures occurring with unpredictable timelines and disrupting service users' routines[14]. This disruption has also been seen in other international settings[15] although data on food access and COVID-19 remains sparse.

The COVID-19 pandemic also substantially impacted the Canadian labour market with one analysis showing a 32 % decrease in aggregate weekly hours worked in early 2020[16]. In Vancouver, particularly in the DTES, many people generate income through informal and often prohibited or criminalised methods, including panhandling (i.e. asking a passerby for money or other goods), recycling (i.e. collecting discarded items to re-sell) and participating in the labour of sex work[17]. The exact impact of COVID-19 on these activities is unknown. However, decreased foot traffic due to retail closures and those of the hospitality industry, as well as a significant decline in travel, may have decreased opportunity for some of these activities and indirectly lessened income generation opportunities for this population/community. Further, to the best of our knowledge, there are no studies investigating whether emergency income supports – such as federal government's Canada Emergency Response Benefit, which provided $CAN 500/week to individuals, or the Government of British Columbia's $CAN 300/month

disability and income assistance top-ups – had an impact on people's food insecurity.

Additionally, the DTES is the epicentre of the drug toxicity/overdose crisis in Canada. The number of overdose deaths increased to unprecedented levels during the early stages of the pandemic[18]. In response to the dual public health crises of COVID-19 and drug toxicity deaths, the province of British Columbia did endorse some public health interventions, including expanding the guidelines for prescribing pharmaceutical medications for PWUD[19]. While the implementation and effectiveness of these interventions need to be scrutinized, food security is a paramount necessity of life that the success of any public health interventions is predicated upon[20]. Therefore, we sought to identify the prevalence of and factors associated with food insecurity amongst PWUD in Vancouver during the first year of the COVID-19 pandemic.

## Methods

### Design, setting and participants

To address this objective, we used a cross-sectional study design. Our data was drawn from three ongoing prospective cohorts of PWUD in Vancouver, Canada: the Vancouver Injection Drug Users Study; the AIDS Care Cohort to evaluate Exposure to Survival Services; and the At-Risk Youth Study. As described in previous literature[21,22], Vancouver Injection Drug Users Study follows HIV-negative adults (aged ≥ 18 years) who injected drugs in the month prior to enrolment. AIDS Care Cohort to evaluate Exposure to Survival Services is a cohort of adults living with HIV who used unregulated drugs (other than or in addition to cannabis) in the month prior to enrolment. At-Risk Youth Study recruits street-involved youth aged 14–26 years who used unregulated drugs in the month prior to enrolment. Participants are recruited through word-of-mouth and street outreach from two frontline research offices in the DTES and Downtown South neighbourhoods. All cohort participants provide written informed consent to participate in biannual interviews by trained interviewers, serology testing and urine drug screens. The study procedures, including the questionnaire that solicits a range of demographic and behavioural information, are harmonized across the three cohorts, which permits pooled analyses. Table 1 presents descriptive statistics of the Vancouver Injection Drug Users Study/AIDS Care Cohort to evaluate Exposure to Survival Services/At-Risk Youth Study participants who answered our primary outcome variable.

The data used for the present study were collected between July and November 2020. During this period, some questions specific to the experiences of living through the COVID-19 pandemic were integrated into the questionnaire. The questionnaire broadly addresses

**Table 1** Participant characteristics and bivariable logistic regression analyses of factors associated with food insecurity among people who use drugs in Vancouver, Canada, July–November 2020 (*n* 765)

| Variable | Food insecurity | | | | | |
|---|---|---|---|---|---|---|
| | Yes (*n* 146, 19·1 %) | | No (*n* 619, 80·9 %) | | OR | 95 % CI |
| | *n* | % | *n* | % | | |
| Age (median, 1st–3rd quartile, per year increase) | | | | | | |
|   Median | 44·7 | | 45·2 | | 0·99 | 0·98, 1·0 |
|   1st –3rd quartile | 32·1–55·2 | | 31·5–55·6 | | | |
| Self-identified as woman or non-binary gender | 69 | 47·3 % | 224 | 36·2 % | **1·74** | **1·20, 2·55** |
| Self-identified as white | 76 | 52·1 % | 332 | 53·6 % | 1·01 | 0·69, 1·48 |
| Self-identified as non-heterosexual | 36 | 24·7 % | 120 | 19·4 % | 1·45 | 0·93, 2·21 |
| Daily opioid use* | 73 | 50 % | 197 | 31·8 % | **2·13** | **1·48, 3·08** |
| Daily stimulant use* | 64 | 43·8 % | 183 | 29·6 % | **1·85** | **1·28, 2·68** |
| Daily cannabis use* | 34 | 23·3 % | 231 | 37·3 % | **0·52** | **0·34, 0·78** |
| Daily alcohol use* | 22 | 15·1 % | 69 | 11·1 % | 1·39 | 0·81, 2·30 |
| Accessed drug or alcohol use treatment* | 95 | 65·1 % | 356 | 57·5 % | 1·42 | 0·97, 2·09 |
| Experienced an overdose | 13 | 8·9 % | 32 | 5·2 % | 1·78 | 0·89, 3·42 |
| Income generation activities | | | | | | |
|   Employment* | 33 | 22·6 % | 147 | 23·7 % | 0·93 | 0·60, 1·42 |
|   Sex work* | 18 | 12·3 % | 42 | 6·8 % | **1·94** | **1·06 - 3·44** |
|   Drug dealing* | 40 | 27·4 % | 137 | 22·1 % | 1·32 | 0·87, 1·98 |
|   Street-based activities* | 49 | 33·6 % | 108 | 17·4 % | **2·37** | **1·58, 3·53** |
|   Illegal activities* | 15 | 10·3 % | 147 | 23·7 % | 1·60 | 0·83, 2·92 |
|   Government COVID support funds | 75 | 51·4 % | 300 | 48·5 % | 1·15 | 0·79, 1·67 |
| Barriers to mobility | 54 | 37 % | 157 | 25·4 % | **1·71** | **1·16, 2·50** |
| Difficulty accessing community health and social services* | 48 | 32·9 % | 83 | 13·4 % | **3·23** | **2·12, 4·89** |
| Current unstable housing | 88 | 60·3 % | 296 | 47·8 % | **1·64** | **1·14, 2·37** |
| DTES residence in the past 6 months | 80 | 54·8 % | 266 | 43 % | **1·61** | **1·12, 2·32** |
|   Self-reported changes in hunger levels since the COVID-19 emergency was declared | | | | | | |
| More hunger | 114 | 78·1 % | 29 | 4·7 % | | |
| About the same | 22 | 15·1 % | 564 | 91·1 % | | |
| Less hunger | 9 | 6·2 % | 25 | 4·0 % | | |

DTES, Downtown Eastside.
Associations that reached statistical significance (*P* < 0·05) are in bold font.
*Denotes behaviours and events in the month prior to the interview.

social and risk factors dynamics within the lives of PWUD who fit Vancouver Injection Drug Users Study/AIDS Care Cohort to evaluate Exposure to Survival Services/At-Risk Youth Study criteria. In compliance with COVID-19 pandemic restrictions in place at the time, the questionnaire was administered by phone calls from interviewers to participants. Participants who did not have access to a phone were offered to pick up a study-owned cellphone for the purpose of participating in an interview. For the present study, we restricted the analytic sample to those who reported having used any drugs (including cannabis) in the past six months and completed a question about food insecurity.

### Study measures

Our primary outcome variable was food insecurity during the COVID-19 pandemic (yes *v.* no), which was derived from a question 'has your access to food been impacted in the last month?' Throughout the time the questionnaire was completed (July–November, 2020), the last month, by default, referred to being during the COVID-19 pandemic. Interviewers read the following four response options: 'yes, I have not had enough money to buy food,' 'yes, I have had

to ration my food so I do run out (e.g. skipped meals, eaten less than I want to),' 'yes, I have not been able to find foods I need in the store' and 'no.' For the first three 'yes' options, participants were allowed to affirm multiple options. Those who selected at least one of the first three 'yes' statements were considered having food insecurity, while those who selected 'no' were defined as having food security.

We then selected a number of explanatory variables that we hypothesized to be associated with food insecurity in our study population based on previous literature[11]. Demographic characteristics included: age (per year increase), self-identified gender (woman or non-binary *v.* man), self-identified race/ethnicity (white *v.* Black, Indigenous or other persons of color), sexual orientation (non-heterosexual *v.* heterosexual), DTES resident in the past six months (yes *v.* no), and having some or extreme barriers to mobility (yes *v.* no), as assessed by EQ-5D-3L, a validated survey instrument to measure quality of life[23]. The remaining variables referred to the past month and were dichotomized as yes *v.* no unless otherwise specified. Socio-economic characteristics included: current unstable housing (defined as living in a single room occupancy hotel, shelter, other transitional housing, or living on the street); employment, sex work, drug dealing, street-based

income generation (e.g. panhandling, recycling, etc.); income generation through other illegal activities (such as theft); and receiving of any COVID-19 government support funds. Drug use patterns included: ≥ daily use of unregulated opioids (including non-medical use of prescription opioids), ≥ daily use of unregulated stimulant (including cocaine, crack or crystal methamphetamine), ≥ daily cannabis use (independently and dependently across polysubstance use), ≥ daily alcohol use and non-fatal overdose. Service access characteristics included: difficulty accessing community health or social services, and/or enrolment in any drug or alcohol use treatment.

### Statistical analyses

Bivariable and multivariable logistic regression analyses were used to identify factors associated with food insecurity. To be included in the multivariable model presented in Table 2, explanatory variables had to be associated at the $P < 0.10$ level in bivariable analyses. Additionally, we ran a multivariable model that included all explanatory variables as a comparison. Because the receipt of COVID-19 support funds may have had differential effects based on the type(s) of income generation activities that participants were engaged, we also examined interaction effects between the receipt of COVID-19 support funds and each of the income generation activities.

In a sub-analysis, we used descriptive statistics to examine changes in self-reported hunger since the pandemic started. Study participants were asked whether they have experienced a change in how often they went hungry due to lack of access or means to get food since the COVID-19 health emergency was declared in March 2020, and one of the three response options was selected: 'yes, more often than usual,' 'no, about the same' and 'yes, less than usual.' We cross-tabulated the responses with the primary outcome variable. We also stratified the responses based on the types of income generation activities.

Finally, as daily cannabis use retained a significant negative association with food insecurity in the multivariable analysis, we also performed a post-hoc analysis in which we used the descriptive statistics to examine polysubstance use patterns among those who did and did not use cannabis on a daily basis. All $P$-values were two-sided, and all statistical analyses were conducted using R Version 3.4.2 (14).

### Results

There were 884 participants who completed interviews during the study period. Of those, 769 (87·0 %) reported having used drugs in the past six months, and 765 (86·5 %) answered the question about food security and were included in these analyses. Among them, the median age was 44·7 (1st and 3rd quartile: 32·1–55·2) years, 408

(53·3 %) self-identified as white, 433 (56·6 %) self-identified as a man, and 346 (45·2 %) resided in the DTES in the past six months. Overall, 146 (19·1 %; 95 % CI: 16·3 %, 21·9 %) reported food insecurity in the past month, of whom 114 (78·1 %) reported that their hunger levels increased since the COVID-19 health emergency was declared in March 2020, and 22 (15·1 %) reported that their hunger levels remained the same before and after March 2020.

Other descriptive statistics and results of the bivariable regression analyses are presented in Table 1. The results of the multivariable analysis are shown in Table 2. As shown, factors that were independently and positively associated with food insecurity included: difficulty accessing health or social services (adjusted OR (AOR) = 2·59; 95 % CI: 1·60, 4·17); having mobility issues (AOR = 1·59; 95 % CI: 1·02, 2·45); and street-based income generation (AOR = 2·31; 95 % CI: 1·45, 3·65). At least daily cannabis use was independently and negatively associated with food insecurity (AOR = 0·61; 95 % CI: 0·37, 0·99). There was no significant interaction between the receipt of the COVID-19 support funds and any types of income generation activities (all $P > 0.05$). When all variables were run through the multivariable model, access to services and street-based income continued to hold significant associations, whereas mobility issues no longer had a significant association with food insecurity 0·96 (AOR = 1·49; 95 % CI: (0·93, 2·38)).

Descriptive analysis of the outcome variable is presented in Fig. 1. As shown, the percentages of those who reported increased levels of hunger during the COVID-19 pandemic ranged from 17·2 % among those employed, to 32·5 % among those who engaged in street-based income generation, with an overall prevalence of 18·7 % (95 % CI: 15·9 %, 21·5 %).

Table 3 shows the results of the post-hoc analysis that included participants who had valid responses to the cannabis use variable. As shown, among those who used cannabis at least on a daily basis ($n$ 265), 57 (21·5 %) and 63 (23·8 %) participants also reported at least daily use of unregulated opioids and stimulants, respectively.

### Discussion

In this cross-sectional study of 765 PWUD interviewed during the first year of the COVID-19 pandemic, approximately one in five individuals reported food insecurity in the past month. Among those who experienced food insecurity, the majority (78·1 %) reported that their hunger levels increased since the COVID-19 health emergency was declared in our setting in March, 2020. In multivariable analyses, those who had challenges accessing services, having mobility issues, or earning income through street-based activities were more likely to report food insecurity. In contrast, those who used cannabis at least on a daily basis were less likely to report food insecurity. Self-reported receipt of government COVID-19 supports funds

**Table 2** Multivariable logistic regression analyses of factors associated with food insecurity among people who use drugs in Vancouver, Canada, July–November 2020 (*n* 765)

| Variable | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|
| | AOR | 95 % CI | *P*-value | AOR | 95 % CI | *P*-value |
| Age | x | x | x | 0·99 | 0·98, 1·01 | 0·518 |
| Gender | | | | | | |
| (woman or non-binary *v.* man) | 1·37 | 0·88, 2·12 | 0·163 | 1·61 | 1·00, 2·59 | 0·052 |
| Sexual orientation | | | | | | |
| (non-heterosexual *v.* heterosexual) | 1·17 | 0·70, 1·92 | 0·541 | 1·13 | 0·67, 1·89 | 0·634 |
| DTES resident in the past 6 months | | | | | | |
| (yes *v.* no) | 1·18 | 0·74, 1·89 | 0·479 | 1·25 | 0·75, 2·09 | 0·237 |
| Current unstable housing | | | | | | |
| (yes *v.* no) | 1·4 | 0·88, 2·22 | 0·157 | 1·34 | 0·83, 2·19 | 0·237 |
| Daily unregulated opioid use[*] | | | | | | |
| (yes *v.* no) | 1·39 | 0·86, 2·24 | 0·175 | 1·3 | 0·78, 2·16 | 0·304 |
| Daily unregulated stimulant use[*] | | | | | | |
| (yes *v.* no) | 0·99 | 0·62, 1·58 | 0·975 | 0·99 | 0·60, 1·62 | 0·965 |
| Daily cannabis use[*] | | | | | | |
| (yes *v.* no) | 0·61 | 0·37, 0·99 | 0·048 | 0·63 | 0·38, 1·04 | 0·077 |
| Sex work[*] | | | | | | |
| (yes *v.* no) | 1·00 | 0·46, 2·07 | 0·997 | 0·99 | 0·44, 2·13 | 0·983 |
| Income via street-based activity[*] | | | | | | |
| (yes *v.* no) | 2·31 | 1·45, 3·65 | < 0·001 | 2·46 | 1·51, 3·99 | < 0·001 |
| Barriers to mobility | | | | | | |
| (yes *v.* no) | 1·59 | 1·02, 2·45 | 0·040 | 1·49 | 0·93, 2·38 | 0·096 |
| Difficulty accessing health or social services[*] | | | | | | |
| (yes *v.* no) | 2·59 | 1·60, 4·17 | < 0·001 | 2·50 | 1·50, 4·12 | < 0·001 |
| Drug or alcohol use treatment[*] | | | | | | |
| (yes *v.* no) | 1·03 | 0·67, 1·61 | 0·892 | 0·99 | 0·62, 1·57 | 0·951 |
| Experienced an overdose[*] | | | | | | |
| (yes *v.* no) | 1·02 | 0·44, 2·19 | 0·963 | 1·18 | 0·51, 2·60 | 0·683 |
| Formal employment | | | | | | |
| (yes *v.* no) | x | x | x | 0·89 | 0·52, 1·48 | 0·658 |
| Selling drugs | | | | | | |
| (yes *v.* no) | x | x | x | 0·86 | 0·49, 1·46 | 0·58 |
| Income via illegal activity | | | | | | |
| (yes *v.* no) | x | x | x | 1·08 | 0·45, 2·40 | 0·86 |

DTES, Downtown Eastside; AOR, adjusted odds ratio.
Model 1: include all variables that held *P* > 0·10 with outcome, model 2: includes all variables.
*Denotes behaviours and events in the month prior to the interview.
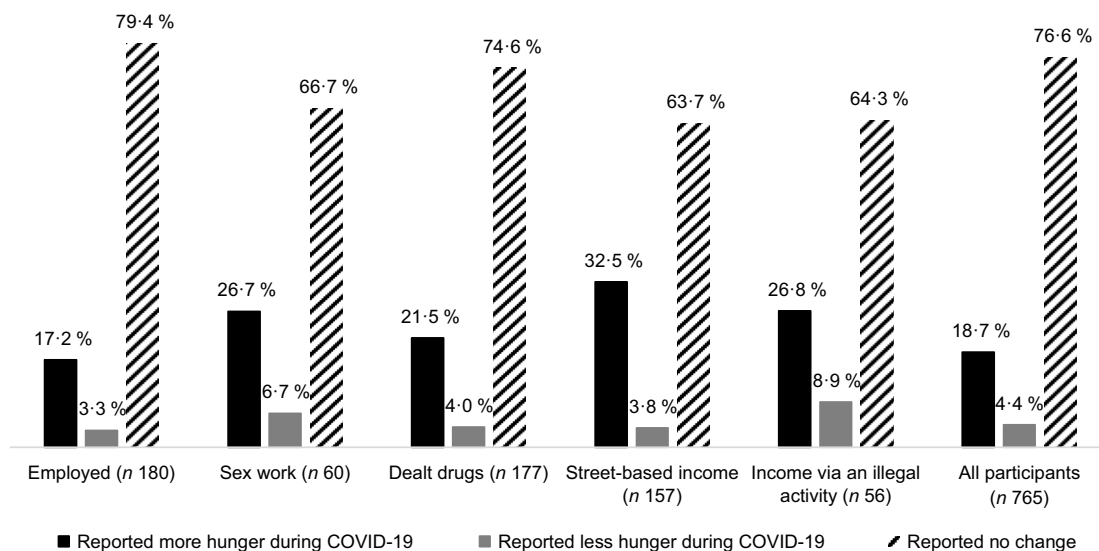


**Fig. 1** Self-reported changes in hunger levels amongst people who use drugs in Vancouver, Canada, during COVID-19 (July–November, 2020)

**Table 3** Daily use of cannabis and other substances among people who use drugs in Vancouver, Canada, July–November 2020 (n 761)

| | Daily cannabis use | | | | | |
| Variable | Yes (n 265, 34·6 %) | | No (n 496, 64·8 %) | | | |
| | n | % | n | % | OR | 95 % CI |
|---|---|---|---|---|---|---|
| Daily unregulated opioid use[*] | 57 | 21·5 % | 211 | 42·5 % | 0·37 | 0·26, 0·52 |
| Daily unregulated stimulant use[*] | 63 | 23·8 % | 183 | 36·9 % | 0·53 | 0·38, 0·74 |
| Daily alcohol use | 36 | 13·6 % | 55 | 11·1 % | 1·26 | 0·80, 1·98 |

*Denotes behaviours and events in the month prior to the interview. OR represent the associations between at least daily cannabis use and each of at least daily use of the other noted substances.

did not appear to modify the relationship between any type of income generation activities and food insecurity.

To date, there is limited information in academic literature about reasons for food insecurity among PWUD. The estimated prevalence of self-reported food insecurity amongst daily opioid and stimulant users in our study, 50 % and 43·8 % respectively, were similar to those identified in previous studies in other settings. One study conducted in Los Angeles and San Francisco, USA found that 41 % of PWUD reported very low food security[24], while another study in Athens, Greece, documented that 37–41 % of PWUD reported having food security across four surveys[25]. However, these studies both occurred before the COVID-19 pandemic, the former was published in 2016, and data collection for the latter occurred in 2012–2013.

Our results found that self-reported food insecurity increased substantially among our study sample in Vancouver since the start of the COVID-19 pandemic and subsequent related regulations. The finding that food insecurity was associated with difficulty in accessing services were not surprising given that the broad closure of local storefronts, including but not limited to social and health services, in response to COVID-19, presents a direct way access would become more difficult. While COVID-19 created a largely unprecedented circumstance, this presents a similar issue to Miewald & McCann's[13] qualitative research as well as grey literature[26] conducted in Vancouver's DTES, which describes limited accessibility to services as a major barrier to food and emphasizes the importance of autonomy in access to nutrition. This phenomenon is not limited to the local context, as there exists a global movement to increase food sovereignty at the community level, including the distribution of food[27,28]. Food sovereignty has a plurality of definitions and nuances but is understood widely as communities making decisions over food systems[28], especially taking control back from private sector forces[27,28]. While Vancouver is already limited in high quality food access, the ability to sit down and/or select a meal became even more limited during the initial phase of COVID-19 restrictions[29], including in the DTES. With closures to dining areas, most food options were concentrated into line-up-based services, which was a concern highlighted in the city's 2005 report[12]. In Vancouver, beyond the DTES, 'pop-up' food banks (satellite spaces that are open for a specific duration) were closed down temporarily, leaving some zones of the city entirely without food banks[29]. This could also help to explain why people who reported mobility challenges had higher odds of food insecurity in the present study.

In our study, participants who generated income through street-based activities were more likely to experience food insecurity. This finding was also consistent with the results of the sub-analysis, in which we found that among all types of income generation activities considered, the prevalence of reporting increased hunger levels since the COVID-19 pandemic were the highest among those engaged in street-based income generation activities. These findings may suggest that the income of these individuals may have been hardest hit by the pandemic. For example, unprecedented international travel restrictions which severely impacted the tourism industry in Vancouver at the time of the study[30]. At the same time, dining in at bars and restaurants faced closures similar to formal food services of the DTES. This may have led to fewer options regarding informal recycling and a lower number of passersby with disposable income to support panhandling. Notably, being a recipient of provincial or federal COVID-related income support funds did not have a significant association with food access. This will require further research to understand.

We also found that those who used cannabis at least on a daily basis were more likely than those who did not to have secure access to food. In addition, the majority (> 75 %) of those engaged in daily cannabis use did not use unregulated opioids or stimulants on a daily basis. With unregulated drug markets disrupted by COVID-19-related border closures[31,32], our findings may align with emerging research from our study setting and population indicating that cannabis might play a role in tapering opioid use[33–35]. In turn, funds saved from inflated opioid costs may have gone towards food for some daily cannabis users. However, our study cannot prove that such transition in drug use patterns has occurred or explains the negative association with food insecurity. Further, our finding may be in contrast to research indicating that THC's interaction with the $CB_1$ receptor could increase feeding intake[36].

Therefore, further investigation regarding this finding is warranted.

This study has limitations. First, the generalisability of our findings may be limited: None of the cohorts included in the present study were randomly sampled. Further, because of institutional guidelines, all interviews were conducted over the phone, which might have affected our ability to reach the most marginalised cohort participants. Although study staff provided temporary access to cellphones for participants who did not have access to a phone, we cannot preclude the possibility that the technical requirements for interviews resulted in excluding some participants. Second, self-reported data may contain some biases, including socially desirable reporting. We note that this variable was not derived from commonly used standardised measures of food insecurity, including the Household Food Security Survey Module[37]. While the Household Food Security Survey Module consists of eighteen questions and measures food access and security in relation to financial constraints only, our question was more concise (for the feasibility reasons due to phone interviews) and sought to measure access to food more broadly. This was important to our analysis as the COVID-19 pandemic disrupted normal life in a multitude of ways outside of income.

Our study adds to the limited international research on food insecurity for PWUD. It does so in a crisis context when many existing health, safety and equity-oriented disparities were accentuated. The study contributes to understanding which sub-population within the broader PWUD demographic are more at risk for food insecurity. It also helps outline local needs around food insecurity for Vancouver. At this juncture, further evaluation on addressing food insecurity for the subpopulations discussed could be through action-based projects and pilots that help contribute to reducing local food insecurity.

These findings suggest the need for a stronger, more unified government response that fits the needs and respects the autonomy of marginalised communities, rather than a mixture of private and public organisations with different criteria and scope providing food security without inherent democratic or community accountability mechanisms, which has been the case in our study setting. Suggestion for further study includes exploring how accessibility can be better integrated into service design and provision when it comes to food security programming for PWUD. Securing the most basic needs such as food is essential for any public health interventions to succeed in addressing the two dueling crisis due to the COVID-19 pandemic and drug toxicity deaths.

## Conclusion

In our examination of food insecurity amongst PWUD in Vancouver, we found that approximately one in five PWUD experienced food insecurity during the early stages of the COVID-19 pandemic and the self-reported hunger levels also increased for the majority of those who experienced food insecurity. Those who experienced difficulty accessing a service when needed, generated income through street-based means and/or had mobility issues were more likely to experience food insecurity. Our findings are based in a time of crisis when specific types of services were interrupted for various reasons. While the pandemic continues, social service organizations could consider adapting targeted outreach to meet the needs of clients with mobility issues, who struggle to access services and/or who may not have time to attend to these services to due to the opportunity costs related to surviving off of a street-based income. Other strategies could include creating seating areas that have protocols in place to protect against the spread of COVID-19. In the post-pandemic era, design for food security services could also incorporate our findings about who is impacted most acutely by a lack of options in service provision.

## Acknowledgements

aspects of the work. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Providence Health Care/University of British Columbia Research Ethics Board. Written informed consent was obtained from all subjects/patients to participate in biannual interviews by trained interviewers, serology testing and urine drug screens. The study procedures, including the questionnaire that solicits a range of demographic and behavioural information, are harmonized across the three cohorts, which permits pooled analyses.

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