Introduction

The COVID-19 pandemic has caused extensive social and economic upheaval, affecting the lives of Canadians and introducing various sources of stress. In addition to the increase in mortality from communicable diseases, the long-lasting socioeconomic uncertainty continues to reveal its effects on public health. Many pandemic-related stressors led to increases in substance use among Canadians since March 2020 (Canadian Centre on Substance Use and Addiction, 2022). Coupled with this is a noticeable difficulty in accessing housing, especially for individuals with substance use disorders and those experiencing homelessness (Galarneau, 2021). Substance use entails the recurrent consumption of alcohol or illicit substances and the improper use of over-the-counter or prescription medications. The use of these substances, whether illicit or not, has become a pressing concern for public health and sociology, representing a significant risk factor for various health issues and premature mortality (Henderson *et al.*; 2021; Rehm & Probst, 2018).

Similar to other social phenomena, substance use varies with socioeconomic status (SES) which encompasses social and economic measures, including employment, education, income, resource access, and relative social position (Baker, 2014). Among these, housing is a crucial yet often under-researched component, where a disproportionate percentage of people with substance use disorder (SUD) also experience homelessness to varying degrees (Henderson *et al.*, 2021). SES and substance use are associated, although directionality remains unclear (Nicholson, 2020). This project investigates the following questions: What is the relationship between access to housing and the rise in current trends of illicit drug use within Edmonton's inner city? How have general trends in illicit substance use changed with the COVID-19 global

pandemic? And, what are some of the consequences of not having housing or adequate income for people who use drugs?

My goals for this project are to understand how and to what extent substance use is linked to housing accessibility and stability at the intersection of the COVID-19 pandemic and opioid epidemic. The project aims to bridge the gap between theoretical frameworks and applied research to address the needs of vulnerable populations disproportionately affected by the pandemic. To achieve these goals, I analyzed survey data provided by the Canadian Research Initiative in Substance Misuse (CRISM) and Inner City Health and Wellness Program (ICHWP), collected by Dr. Elaine Hyshka and her team at the University of Alberta. The dataset comprises 503 participants, most recruited from Edmonton's inner city. The survey predominantly covers sociodemographic factors like housing, income, substance use, and access to safe supplies. Guided by a Social Determinants of Health (SDOH) perspective and its connection to Diseases of Despair, I used multivariate models and descriptive statistics to examine the relationships between housing, both accessibility and stability, and substance use for people who use drugs (PWUD).

2. Key Measures and Methods

Key Measures

The total number of participants used for this study was n = 450, and most participants came from Edmonton's inner city. For this study, around 16 variables were picked and sorted into either the housing or substance use categories. Due to how the survey questions were designed and encoded, all 16 variables are either nominal or ordinal variables that had to be recoded from

numerical variables into ones with categorical names in accordance with the codebook. Aside from renaming the different categories for each of the 16 variables, I did not regroup or redefine any of the variables.

2.1 Housing

One of the key predictor variables for this project is housing. In particular, I use Questions 8, 10, 11, and 12 of the *Survey of people who use drugs* to compare the severity of drug use among groups of people who do and do not report having access to housing within participants in Edmonton's inner city population. Housing, according to the survey, is defined as "[a] permanent or semi-permanent place where you live, either independently or with other people" (Hyshka, 2023, p. 3).

Starting with Question 8, which asks whether or not participants currently have housing, an overwhelming majority of participants ($n = 404$) reported that they did not have housing as defined by the survey. This variable is a nominal variable, where each participant was identified in one of 6 categories, either "Yes" (1), "No" (0), "Don't Know" (666), "Refused" (777), and "Not answered" (888), which were then recoded to indicate yes, no, and unknown. Of the 503 participants, roughly 80.3% reported not currently having access to housing, and only 19.5% reported that they did currently have access to housing.

Question 10 delves further into the housing situations of participants by asking how they would describe their current housing situation. Question 10 is an ordinal variable, with categories ranging from very unstable to very stable housing. Roughly 401 participants reported being in unstable housing situations, with 335 or 66.6% of the sample reporting very unstable housing.

Both questions 8 and 10 are important in assessing the current state of housing experienced by participants in the survey. However, they are limited in that they only offer a

cross-sectional view of housing and do not provide much to compare the housing situations of participants pre and post-pandemic. Therefore, questions 11 and 12 were also picked because they focused on comparing housing before and during the pandemic. Question 11 asks whether participants had undergone a change in living situations during the COVID-19 pandemic. Question 11 was coded similarly to Question 8 in the original dataset and was recoded similarly since both are nominal variables with primarily yes or no responses. Overwhelmingly, 80.9% of participants reported that their living situation had changed during the COVID-19 pandemic. Question 12, on the other hand, asks whether participants had noticed any changes to how difficult or easy it was for them to find a place to stay, where answers ranged primarily in one of three categories: more difficult than usual, same as usual, and easier than usual. Of the participants who responded, the largest group reported that it was more difficult than usual at 69.6%.

Questions 11 and 12 will be used to compare housing between pre-pandemic conditions and during the current pandemic. The reason for choosing these two questions is because they help to illuminate some of the difficulties in housing accessibility we can expect in the advent of a global pandemic

2.2. Substance use

My primary outcome variable is substance use based on questions 22-29, 33, and 34. Questions 22-29 ask participants about their substance use patterns in order to assess the severity of their situation. For this study, Questions 22-29 will be combined into a composite variable to represent the degree or severity of substance use issues. The combination of these questions will be used to compare groups of participants who currently do have housing with those who do not to see if

there is a significant link between the lack of housing and the severity of problematic substance use. Questions 22-29 are all ordinal variables, where participants are placed into about four to five different ranked categories. All the questions in this set were recoded into their respective categories from numerical values.

Some of the questions within this set were particularly striking. For instance, Question 24 asks how often participants are influenced heavily by drugs; a little over half of the sample reported daily or almost daily usage at 51% or weekly usage at 14.1%. These two groups represent the two largest categories for Question 24. Question 25 and Question 26 ask participants about compulsions they may have faced over the past year when it came to drug use. For both of these questions, the largest group of participants reported daily or almost daily compulsive substance use. Similar trends were also present for Questions 28 and 29, which delve further into the extent of participants' substance use.

I also wanted to take a closer look at question 33 because, like Questions 11 and 12, question 33 also seeks to compare pre-COVID and current situations of participants. Question 33 is focused primarily on comparing participants' experiences with substance use before and during the pandemic. Question 33 is an ordinal variable, ranging in options from has decreased, has not changed, and has increased. Nearly 51.1% of participants (n = 257) reported that their illegal substance use has increased. This variable was also recoded to represent the different categorical variables. Furthermore, Question 34 asks participants if they perceive their substance use to be a problem, and roughly 60% reported that they believed their substance use to be a problem. These two questions can be incorporated into the project in order to highlight the lived experiences of

participants in Edmonton's inner city and how their substance use might have shifted during the pandemic.

Methods

To examine the link between drug use and housing, a variety of different regression models were used to determine the different aspects of how housing interacts with drug use. This includes examining the link between participants who indicated whether or not they simply had housing along with other aspects of housing such as accessibility and stability of housing and its link to the severity of illicit drug use.

In order to do so, questions 21-31 of the *Survey of people who use drugs* were compiled into a composite variable known as a Drug Use Disorders Identification Test (DUDIT) variable. The DUDIT is a psychosocial metric that is designed to assess the identification and severity of drug-related problems among participants in research studies, ranking scores from 1 to 44 (Berman *et. al*, 2003). The purpose of the DUDIT in this study was to assess the severity of illicit drug use based on how they answered questions 21-31 of the survey. For the purposes of this study, I plan on treating the DUDIT composite variable as an interval ratio outcome variable in order to use it for regression analysis. The updated sample size for this study using the DUDIT scale and accounting for missing responses came to be n = 450.

<u>Part A: Current Housing and Severity of Drug Use</u>

The first question I wanted to answer was: What is the relationship between having current housing and the rise in current trends of illicit drug use within Edmonton's inner city? For this question, I used a multiple regression model that utilized Questions 5, 6, and 8 of the survey as

predictor variables to assess the severity of illicit drug use reflected by the DUDIT scores at the 95% confidence level. A multiple regression model was appropriate for this question because I wanted to see if there was a link between simply having access to housing, answering either yes or no, and the DUDIT scores. However, housing itself is not the sole determinant of how severe illicit drug use can be, as previous literature has shown, but due to a host of other factors as part of the social determinants of health. As a result, I also include income and education as markers of socioeconomic status, mainly because these variables tend to be definitive and stable over time and because prior literature has shown that these variables are consequential in predicting patterns of illicit drug use. Questions 5 and 6, which asked participants about their highest level of education completed and their total income over the past year, were used as controls for this regression model. Additionally, since I decided to treat the DUDIT variable as an interval-ratio variable, it allowed me to use a multiple regression model to test the link between the three predictor variables and a quantitative outcome variable.

Part B: Housing stability and Severity of Illicit Drug Use

While question 8 in Part A determined whether participants currently had housing, it is important to consider that housing has multiple dimensions and that housing as a variable is seldom ever understood to be binary (as represented in question 8). Therefore, the second question I wanted to explore was housing stability. The research question for Part B is: Is there a link between the degree of housing stability and drug use in Edmonton's inner city? The outcome variable for Part B also utilizes the DUDIT scores. However, there are two noticeable differences between Part A and Part B. Firstly, Part B examines the link between Question 10, which asks participants to identify how stable they would consider their current housing situation to be and DUDIT scores. Secondly, I decided to use a simple linear regression model to answer this question because I

wanted to assess the link between the different levels of housing stability and their respective

DUDIT scores. Since the DUDIT variable is again being treated as a quantitative outcome

variable, a simple linear regression is appropriate for answering the question for Part B in

assessing the association between housing stability and severity of drug use.

Part C: Housing Access and Severity of Drug Use During COVID-19

Along with housing stability, I was also interested in exploring housing accessibility during the

pandemic. For this section, the main objective was to assess the link between housing

accessibility and the severity of drug use. In other words, is there a link between housing

accessibility and drug use among residents in Edmonton's inner city during the COVID-19

pandemic? For this part, I was deliberately shifting my attention toward understanding the role of

housing accessibility within the context of the pandemic. In order to do so, I used question 12 of

the survey as my predictor variable, where participants were asked to report whether they noticed

any change in how easy or difficult it was to access housing since the pandemic was declared in

2020. As with Parts A and B, Part C also uses the DUDIT variable as the outcome variable to

assess the severity of illicit drug use.

A simple linear regression was used to explore the relationship between housing

accessibility and DUDIT scores. Again, because I was interested in seeing how these two

variables were linked to one another, a simple linear regression was appropriate to use. I

refrained from using a multiple regression model where I controlled for income and education

because I was specifically interested in looking at pandemic-related conditions. In addition,

question 6 asks for participants' income level and only asks to report total income over the past

year instead of income since 2020, when the pandemic was declared. Since there would be a

timeline discrepancy in the measurement between questions 6 and 12, I decided to use a simple regression model for this section instead.

Part D: Housing change and Illicit Drug Use

For Part D, the main question I was interested in exploring was: Is there a link between changes in housing situations and an increase in overall illicit drug use since the start of the COVID-19 pandemic? For this question, I decided to use question 11 of the survey, which asks whether participants had a change in living situations during the COVID-19 pandemic as the predictor variable. For the outcome variable, I decided to use question 33, which asks whether participants' overall use of illegal drugs has changed since the COVID-19 pandemic was declared. Since my outcome variable is not an interval ratio variable, I used logistic regression to answer this question. It is also possible to use an ordered logistic regression model to answer this question; however, since my goal was to see if there was a link between an increase in illicit drug use and a change in housing situation, I decided to use a logistic regression model.

Furthermore, I divided up the answers for question 33, where participants were initially given three options of "had increased," "had not changed," and "has increased" into two categories in order to fit a logistic model. In order to do so, I recoded this variable so that all participants who answered "had not changed" and "had decreased" were put into the referent group, whereas participants who answered "had increased" were put into a separate one. Thus, question 33 had to be modified slightly to be used in a logistic regression model.

3. Analysis and Results

Attached separately is an .Rmd and HTML file.

When I ran the multiple regression model in R, the results showed a significant correlation between housing and DUDIT scores. In particular, the correlation between the two variables is negative. A lower score for housing is associated with a higher DUDIT score. While education did not have a significant enough effect for this sample size, income did. The relationship between income and DUDIT scores was positive, indicating that a higher income was associated with a higher DUDIT score and vice versa. Therefore, I found significant relationships from this regression model at the 95% confidence interval between the DUDIT scores and whether or not participants currently had housing along with participants' total income over the past year ($p < 0.025$ for each). Education, on the other hand, was not significant in predicting participant DUDIT scores. From this model, it can be concluded that simply having access to housing was associated with a lower severity of drug use, when controlling for education and income.

Overall, the model for Part A had an F-statistic of 2.844 at (7,442) degrees of freedom and was significant in predicting DUDIT scores, with a p-value 0f 0.0066. This conclusion is further confirmed by examining the confidence intervals, which provided similar conclusions to the regression model for Part A. In summary, the model was significant in predicting DUDIT scores, where factors like housing and income were useful predictors for the severity of illicit drug use for participants in the study.

Examining the bivariate relationship between whether or not participants currently had access to housing and their DUDIT scores using a box plot showed some interesting results.

Those who answered "No" were skewed more to the right than those who answered "Yes" and had a slightly smaller spread, as reflected by a narrower IQR. The "Yes" group tended to have a more symmetric distribution than the "No group." The median DUDIT score and first and third quartiles DUDIT scores were higher for the "No" group than the "Yes" group. This indicates that generally, those who answered "No" to whether they currently had housing were more likely to present with higher DUDIT scores.

Conversely, when examining the bivariate relationship between income and DUDIT scores, there was a lot more variation among the different groups of participants and their DUDIT scores concerning their income levels. Most noticeable are the groups that answered their combined income to be between $60,000 to $79,999 and $80,000 to $99,999. Their spreads are much lower than the other groups, where participants in these two groups tended to have higher DUDIT scores with slight variation. There is a significant positive skew for the $60,000 to $79,999 group and a moderate positive skew for participants who reported having an income over $100,000. A single outlier for the group reported having a total combined income between $60,000 and $79,999 with a lower DUDIT score than the rest. Additionally, the median DUDIT scores were higher for the three largest income groups than the three lowest, indicating a positive correlation between income level and DUDIT scores, as reflected in the multiple regression model. Spreads for the higher income groups were also smaller compared to the lower income groups, which had more variation in their DUDIT scores.

Part B: Analysis and Results

When running this model, I noticed a similar pattern between housing stability and DUDIT scores that was present between housing and DUDIT scores in Part A, where there was a negative correlation between housing stability and DUDIT scores. The lower the stability of housing, the higher the severity of illicit drug use.

The simple linear regression results showed significance between housing stability and participant DUDIT scores at the 95% confidence interval ($p < 0.025$). The overall model was significant in predicting DUDIT scores based on the level of housing stability, with an F-statistic of 18.14 on (1,488) degrees of freedom, with a p-value lower than 0.025. The Pearson correlation coefficient was roughly - 0.197, indicating a weak negative relationship between the two variables. This indicates that while housing stability is a significant predictor of the severity of drug use as measured by the DUDIT scale, there are other important determinants as well. This is not surprising, as indicated by the background literature review, where problematic substance use is often associated with a host of different social determinants of health.

There are a few noticeable characteristics when examining the boxplot of DUDIT scores as a function of housing stability. One, the group that reported very unstable housing had a higher IQR for their DUDIT scores, where most participants reported higher scores than the other groups. The median DUDIT score for this group was higher than the others. There were a few outliers in this group, however. Generally, all the groups besides the "Very stable" group are symmetric in their distributions. The dispersion of DUDIT scores for the "Very unstable" and

"A little unstable " groups was higher than the other groups. This indicates that those with less stable housing generally tended to report higher DUDIT scores.

<u>**Part C: Analysis and Results**</u>

As with the results on housing seen in parts A and B, the regression model for part C yielded similar results. There was a negative correlation between the degree of housing accessibility and the severity of illicit drug use among participants in the study. In essence, those who reported lesser accessibility of housing since the pandemic being declared in March of 2020 were more likely to report higher DUDIT scores. The results of this regression model were significant at the 95% confidence level ($p < 0.025$). Overall, the model yielded an F-statistic of 7.036 on (1,448) degrees of freedom and a p-value of 0.0083. Thus, the correlation between housing accessibility during COVID-19 and the severity in illicit substance use was statistically significant. That being said, the Pearson correlation for this model was -0.124, which indicates that, unsurprisingly, there were other determinants influencing the severity of illicit drug use for participants in this study during the COVID-19 pandemic. So, while housing accessibility is a prominent predictor for illicit substance use during the pandemic, there are other factors that still need to be considered among this demographic.

When looking at the box plot between housing access and DUDIT scores, participants who reported accessing housing "easier than usual" or "more difficult than usual" had positively skewed distributions. In contrast, participants who reported finding no difference in accessing housing had a negatively skewed distribution. Those who reported finding it more difficult than usual to access housing had a higher median DUDIT score compared to the other two groups and a higher first and third quartile. The dispersion of scores was larger for the "Same as usual" and

"More difficult than usual" groups in DUDIT scores compared to the "Easier than usual" group, which had a noticeably smaller box and slightly more symmetric distribution compared to the other two groups.

<u>**Part D: Analysis and Results**</u>

When conducting a logistic regression analysis between whether or not participants experienced a change in housing situation since the beginning of the pandemic and their overall change in patterns of drug use, there was a positive correlation found between the two variables. In essence, change in housing during COVID is positively associated with a change in illegal drug use in a single week. Those whose living situation changed since the start of the pandemic were more likely to report an increase in illicit drug use in a single week. The results of this logistic regression were significant at the 95% confidence level. However, the Pearson correlation coefficient was 0.0303, indicating a weak model fit. Change in living situation during COVID explains only 3.03% of the variation in illicit drug use. Again, this is not surprising given background research on illicit drug use, not only because of the various social determinants of health but also because housing as a concept is multifaceted and complex to quantify within the scope of this model. It does offer insight into how pandemic-related housing conditions have been associated with an increase in drug use, which may help with further research and informing policy in future studies.

Since this model's predictor and outcome variables were categorical, a bar chart was used to compare drug use between participants who reported "No" versus "Yes" to whether their housing situation changed during the pandemic. There was a noticeable difference in the increase in drug use between participants in the "Yes" and "No" categories compared to all other options.

For all changes in drug use on the survey, those who answered "Yes" to a change in living situations had larger frequencies for all three changes in drug use compared to the "No" category. However, this is also because, in general, most participants in this study reported changing living situations since the beginning of the pandemic in early 2020.

In summary, there is a significant correlation between a change in housing situations and illicit drug use throughout the pandemic. This correlation is positive, meaning that typically, participants who reported a change in their living situation were also more likely to report an increase in drug use. This model has a weak correlation coefficient, which indicates that other factors besides changes in housing conditions played a role in the changes in illicit drug use.

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