Part 4 - Project Report

Study: Will County drug overdose epidemic during the COVID-19 pandemic

1. Introduction

"There were 91,799 drug overdose deaths in the U.S. in 2020, a 30% increase from 2019, which began accelerating in March 2020. [1,2] The COVID-19 pandemic was declared a national emergency on March 13, 2020, and from March 1–May 31, 2020, 42 states and territories issued mandatory stay-at-home orders. [3] The pandemic and vital public health mitigation measures designed to reduce disease spread potentially led to unintended social and economic consequences (e.g., depression, health care disruption), which can increase overdose risk. [4,5] These consequences, combined with interruptions and changes in illicit drug supply, possibly contributed to increased fatal overdose risk for people who use drugs (PWUD). [6,7]

Multiple reports indicate drug overdoses have increased during the COVID-19 pandemic. [8-12] In December 2020, the Centers for Disease Control and Prevention (CDC) issued a health advisory highlighting provisional data indicating a substantial increase in overdose deaths beginning in 2019 and accelerating in early 2020, and called for essential services to remain accessible for those at risk of overdose. [2] However, data are limited on COVID-19-specific circumstances that may have contributed to the rise in overdose deaths, particularly leading up to and after the implementation of mitigation strategies."

"The number of fatal drug overdoses has increased since 2019 with treatment and harm reduction services complicated by the ongoing COVID-19 pandemic. The goal of this project is to understand the state of the drug epidemic in Will County during the COVID-19 pandemic. This project also includes demographic data that indicate a continuation of the reported racial disparities, with non-Hispanic Black or African American populations continuing to be disproportionally affected by drugs."

This analysis is important because this analysis can help us understand how COVID-19-specific circumstances might have contributed to overdose deaths across Will County and inform prevention and response efforts for future emergencies.

2. Background/Related Work

Drug overdose has been a major problem in the United States. Drug overdose deaths in the US increased in 2019, despite a slight decrease from 2017 to 2018; this increase was largely driven by illicitly manufactured fentanyl. The opioid epidemic has also been complicated by the increasing use of methamphetamine in combination with opioids. With the emergence of the Coronavirus at the beginning of 2020, subsequent disruptions in health care and social safety nets combined with social and economic stressors fueled the opioid epidemic. Several studies have been done at the national and state level to understand the effects of the pandemic on the drug epidemic.

These research and studies bring majorly talk about the following points:

- Mental health impacts, such as depression, anxiety, or stress about COVID-19, or resulting from mitigation measures potentially contributed to overdose deaths.
- People experienced job loss and financial strain, which potentially contributed to overdose deaths.
- The pandemic also resulted in altered living arrangements, including relocation to avoid exposure, staying with relatives, and experiencing housing instability or homelessness which potentially contributed to overdose deaths.
- Some victims had potential COVID-19 exposures, symptoms, and/or diagnoses leading up to or at the time of death.
- Potential bystanders were sometimes unable to intervene and possibly prevent the fatal overdose because they were spatially separated (e.g., in a different room) or not present because of COVID-19 precautions leading to overdose deaths.
- Substance Use Disorders (SUD) treatment changes were delayed or denied treatment and transitions to virtual sessions, potentially contributing to overdose deaths.
- Other clinical-related changes like canceled or postponed medical care due to COVID-19, or fear of seeking care during COVID-19 potentially contributed to overdose deaths.
- Some victims were released early from the criminal justice system because of COVID-19 and may not have had appropriate linkage to SUD care or treatment, or suitable housing.
- The studies also indicate a continuation of the reported racial disparities, with non-Hispanic Black or African American populations continuing to be disproportionally affected by drugs

By going through this research, I understood that there were multiple reasons through which the pandemic impacted the drug overdose deaths, and how drastic the effect of the pandemic was on some members of the society. Considering this, I wanted to investigate if there were similar patterns in Will County as that was observed in the national study of the United States and the state-level study of Illinois. This led to the research questions that I tried to answer through this project:

- How were fatal and non-fatal overdoses influenced by the pandemic?
- How were different demographic affected by the pandemic?

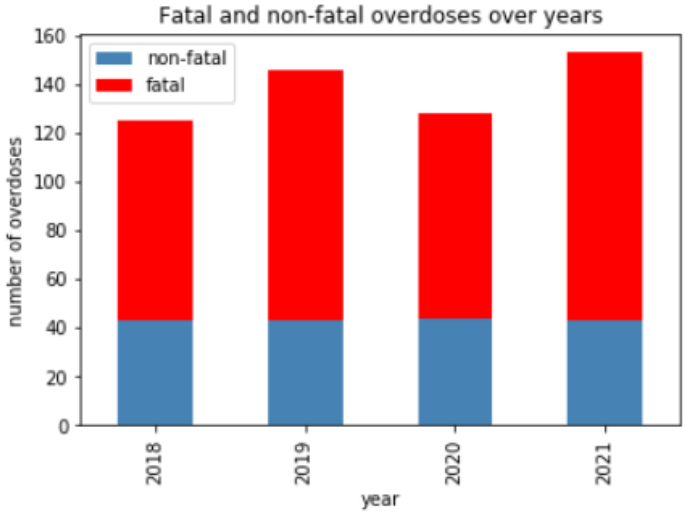
3. Methodology

The main goal of this analysis is to bring to light a narrative about the change in the drug overdose epidemic during the COVID-19 pandemic. This will help inform prevention and response efforts for future emergencies. So, this narrative should be accompanied by data visualizations and statistical tests. I try to present multiple visualizations of these questions so that the narrative reflects an unbiased and holistic understanding of the change in the drug overdose epidemic during the COVID-19 pandemic in a way that does not reflect my assumptions or preconceived notions on the subject.

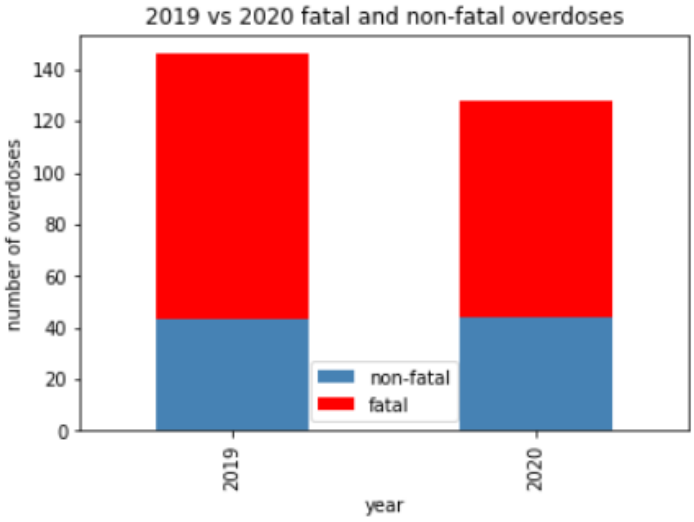
We can convey a lot more information with visualization, and we can concentrate on the bigger picture which is the broader understanding of the data. Rather than being fixated on assumptions that statistical testing requires, we can focus on what the narrative actually represents. It is also important to keep in mind that many outcomes that are statistically significant may not necessarily be meaningful practically. A low p-value doesn't tell us anything about the significance of the observed difference; it just tells us that the distributions are different.

However, if and when data visualization does not represent something clearly, we use statistical tests to verify our hypothesis. Because a statistical test provides a mechanism for making quantitative decisions about a process or processes.

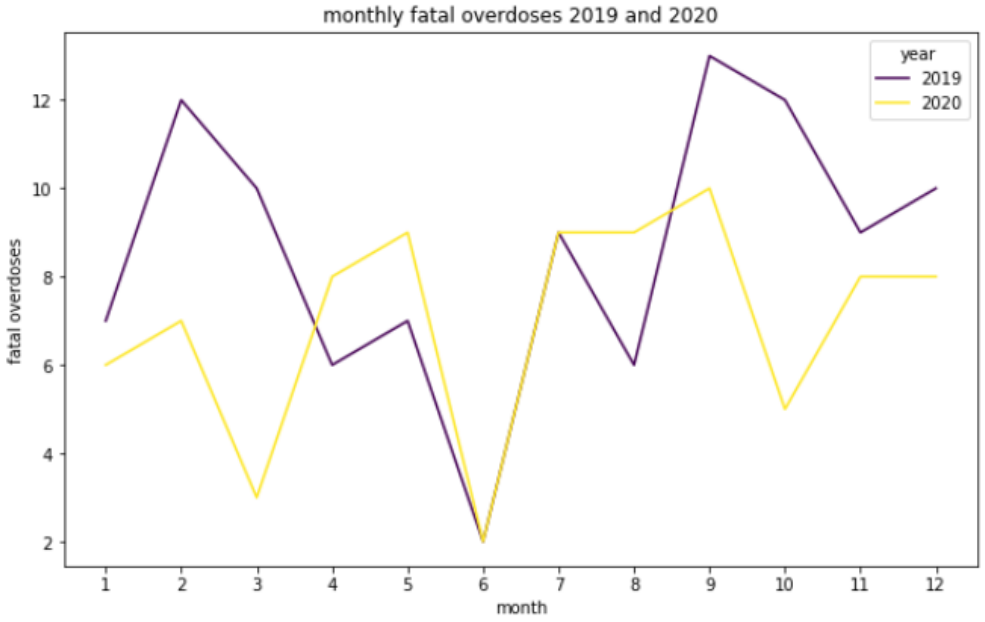
4. Findings



The above graph denotes the fatal and non-fatal overdoses over the years 2018 to 2021. This graph clearly demonstrates that while there were no changes in the number of non-fatal overdoses, there was a change in the number of fatal overdoses over the years. This clearly states that even when there was a change in the total number of cases, the number of people that received medical attention and were saved as a result did not change. However, we cannot come to the conclusion that fewer people were saved as a result of treatment changes that were delayed or denied treatment. This is because there are a lot of underlying reasons that led up to this result which need to be qualitatively examined to come to a solid conclusion.



The above graph shows unusual results. The literature review suggested that the COVID-19 pandemic severely affected the drug epidemic in the country. While this was true for the national studies (United States) and state-level studies (Illinois), this is not the case for Will County. We saw a considerable decrease if not significant in the number of fatal overdoses in 2020 (with the onset of the pandemic) as compared to 2019.



To understand the change in the number of fatal overdoses between 2019 and 2020, I tried to go into more granularity by plotting monthly fatal overdoses. This allows us to get a detailed picture of the progress of the number of fatal overdoses in the year rather than just comparing two numbers - the number of fatal overdoses in 2019 to the number of fatal overdoses in 2020. The above graph was an attempt to understand the monthly distribution of fatal overdoses in 2019 and 2020. However, this graph does not demonstrate the necessary insights to make an inference.

Hypothesis test:

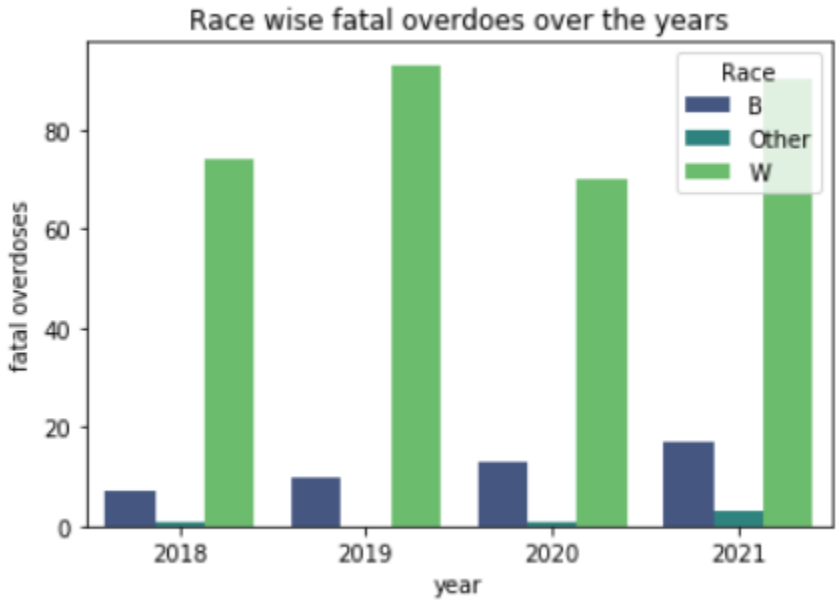
> Null hypothesis: The average monthly overdoses for 2019 is equal to the average monthly overdoses for 2020

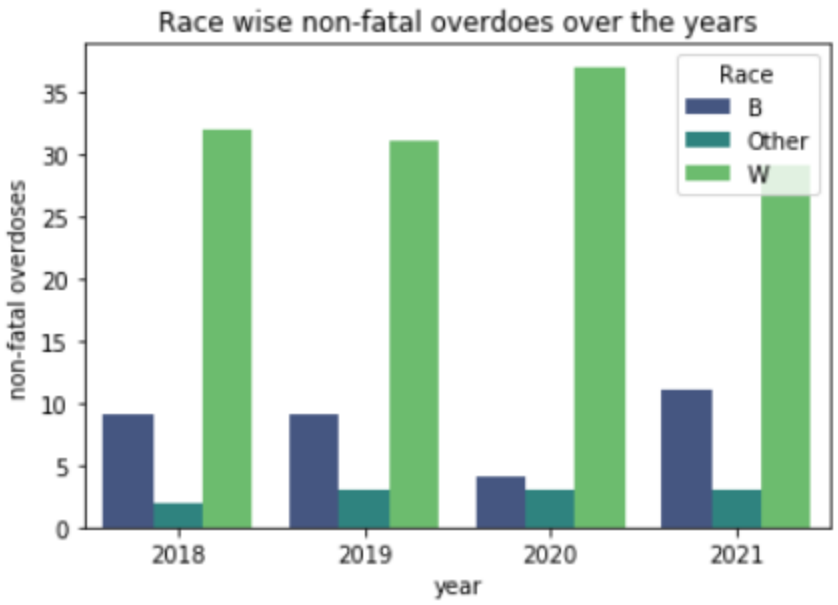
Sample Mean 1 $(\bar{X}_1)$ =	11.92
Population Standard Deviation 1 (σ_1) =	3.09
Sample Size 1(n_1) =	12
Sample Mean 2 $(\bar{X}_2)$ =	10.25
Population Standard Deviation 2 (σ_2) =	3.52
Sample Size 2(n_2) =	12
Significance Level (α)	0.05

$$H_0 : \mu_1 = \mu_2$$

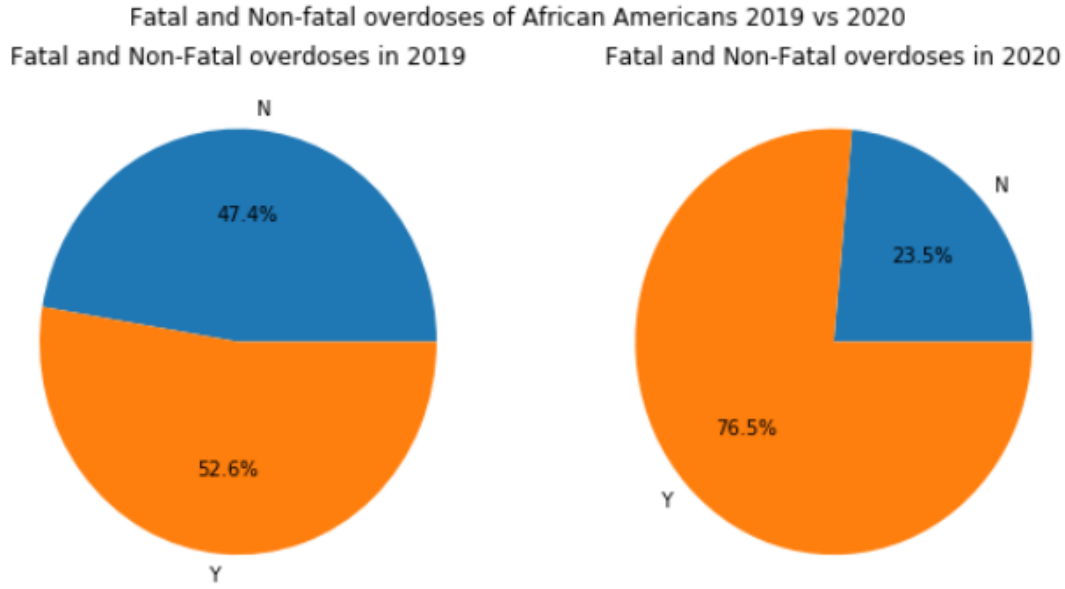
$$H_a : \mu_1 \neq \mu_2$$

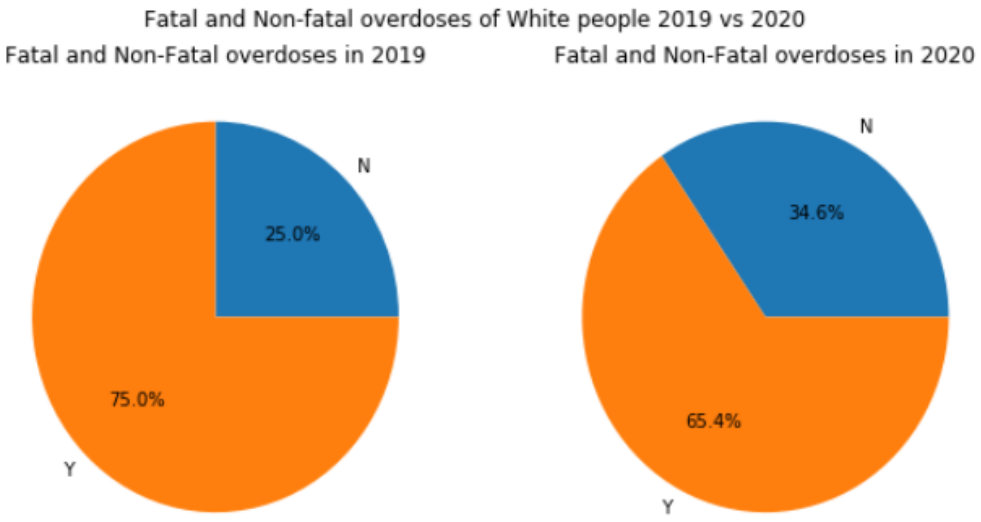
To test this hypothesis, I performed a two-sampled z-test. The z-stat was |z| = 1.235, it is then concluded that *the null hypothesis is not rejected.* Therefore, there is not enough evidence to claim that the average monthly overdoses for 2019 are different than the monthly overdoses for 2020 at a 0.05 significance level.

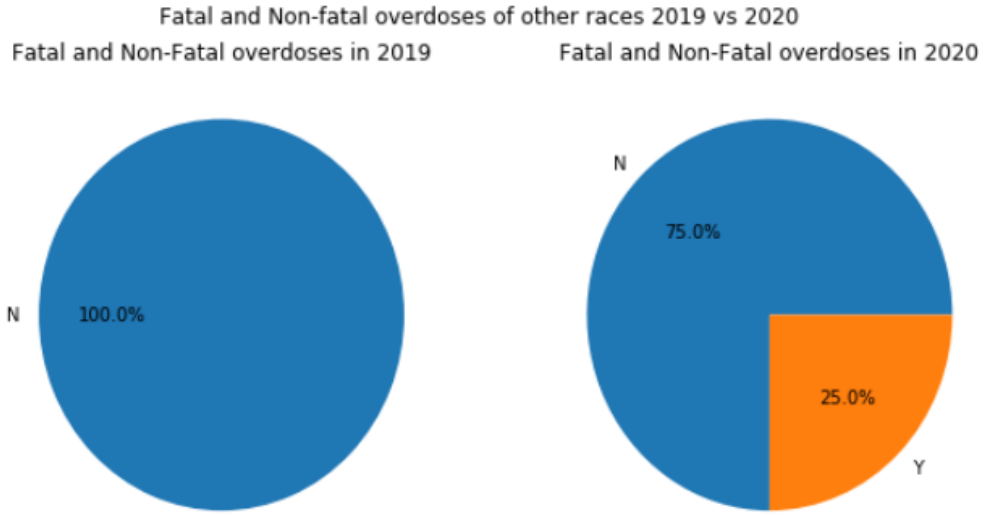




White people seemed to be the most affected by the drug overdose epidemic. However, I see an interesting result even though there was an increase in the number of non-fatal overdoses amongst White folks, there was a decrease in the number of fatal overdoses in 2020 as compared to 2019. Also, it is interesting here to note that this was exactly the opposite for people of color. While there was an overall decrease in non-fatal overdose cases, there was an increase in fatal overdoses in 2020 as compared to 2019 for African Americans. This is a little unusual. And I decided to investigate more.







These pie charts denote that there was a clear increase in the percentage of fatal overdoses in African Americans and other races, even though there was a decrease in total cases. However, for White people, there was a decrease in fatal overdoses even when there was an increase in total cases. This makes us question if there is some sort of bias involved when it comes to the treatment of drug overdose based on the racial profile of the victim. While the data at hand might suggest something of the sort, we can't definitively say this is the case until we have more qualitative data on hand. These differences might have occurred due to multiple other reasons which are not represented in the data. 5.

5. Discussion/Implications

First of all, there was no observable difference between the non-fatal overdoses between 2019 and 2020. While there was no significant difference between fatal overdoses as well, we could still observe that there was a slight decrease in fatal overdoses in 2020 as compared to 2019. The situation was not similar to what was observed at the country level and state level which inspired these research questions to be explored.

We also observed that different demographics were affected by the drug epidemic and the COVID-19 pandemic in different ways. Even though with this analysis, we necessarily don't understand the reason behind such a difference, we still understand that it is an important issue. In the future, this question could be answered by a qualitative study of circumstances surrounding drug overdose deaths during the early stages of the COVID-19 pandemic. This could include considering other factors that were changed with the onset of the pandemic (like Mental health impacts, employment, clinical changes, living arrangements, SUDs, and much more) that in combination influenced this difference. Such data could be collected as a human-centered approach from death certificates and medical examiner/coroner (ME/C) reports, including death scene investigations and postmortem toxicology, to capture decedent demographics, overdose-specific circumstances, and drugs involved (i.e., listed as the cause of death). Additionally, abstractor-drafted case narratives provide context not captured through discrete fields. This activity could be then reviewed by professionals and data scientists consistent with applicable federal/state law and CDC policy.

The simplistic nature of our analysis method helped us understand at a high level not only the story of how the pandemic affected drug overdose, but also ask follow-up questions such as why we saw some things and whether these observations were in line with what we hypothesized initially. Furthermore, Qualitative measures of how the socioeconomic conditions changed are not documented in this analysis – knowing a little more about them would be valuable. Though we mustn't forget, a quantitative analysis of the data is what led us to identify this issue to be of pertinence in the first place.

6. Limitations

Some limitations stem from the way data was collected.

1. We observe various discrepancies in the 'Race' column. For example, in the below snippet, we can see that the White race is denoted by 'W' and 'w'.

We also see that while some are denoted using entire words like Mexican, and Asian, some are just denoted using letters, which makes it difficult to correctly identify which racial class a particular person belongs to. Also, some categories like Mexican fall under the category of Hispanic. The categories are not well defined. To clean this, I considered all categories except B and W as Other and moved forward with the analysis since there were less than 5 cases that fall under this category each year. It would have been easier to clean this data had there been any data dictionary that tells us what exactly each of these categories means.

```
overdoses['Race'].value_counts()
```

```
W           446
B            78
M             6
Mexican       1
B/W           1
Hispanic      1
A             1
K             1
H             1
Asian         1
w             1
Korean        1
Name: Race, dtype: int64
```

2. There was a similar problem observed in the 'Sex' column too. 'F', 'f', 'W', and 'Female' represented the same category. But again, this was an assumption made on my part as there was no data dictionary to verify this. I however combined these under a single category.

```
overdoses['Sex'].value_counts()
```

```
M         392
F         142
W           2
Female      1
f           1
B           1
Name: Sex, dtype: int64
```

3. By examining the dataset, I believe that the entire data was manually entered and is prone to manual errors and/or manipulation. As there is no description of how the data was collected and how was it coded, the data might not be accurate.

4. Since the data might not be accurate, I am assuming that it follows a normal distribution and assuming that all the requirements are met for a statistical test which might or might not be the case.

5. Finally, the most important point, we can see some correlation between COVID-19 cases and the drug overdose cases, but that cannot simply be considered the causation. We need to consider various other underlying factors that we described in the previous section.

7. Conclusion

From this analysis of drug overdose and COVID-19 cases, we were able to understand some interesting patterns that even though there was a countrywide increase in drug overdose cases with the onset of the pandemic, Will County in Illinois did not follow the same trend. In fact, there was a decrease in the number of cases. Furthermore, there were unusual results in the number of fatal overdoses when we tried to look at the data based on demographics.

Understanding the timeline of drug overdose helps us build intuition of the ideas that guided policy in Will County, Illinois. To build a complete understanding of this, we must also understand the timeline from a “thick data” point of view and not just make assumptions off data that we were able to analyze and observe. Qualitative measures of how the socio-economic conditions changed are not documented in this analysis – knowing a little more about them would be valuable. Though we mustn’t forget, a quantitative analysis of the data is what led us to identify this issue to be of pertinence in the first place.

8. Data Sources

The RAW_us_confirmed_cases.csv file from the Kaggle repository of John Hopkins University COVID-19 data: https://www.kaggle.com/datasets/antgoldbloom/covid19-data-from-john-hopkins-university?select=RAW_us_confirmed_cases.csv

The RAW_us_deaths.csv file from the Kaggle repository of John Hopkins University COVID-19 data: https://www.kaggle.com/datasets/antgoldbloom/covid19-data-from-john-hopkins-university?select=RAW_us_deaths.csv

The data on Overdoses and Overdose deaths is available on the Will County's website for the years: 2021, 2020, 2019 and 2018. The problem with this is that the data is not readily available as a .csv or .xlsx but it is available as a part of the HTML. The data consists of all the overdose cases over the years, with information like race, sex, age of the victim, and the date, cause, agency, and manner of the overdose.

The Opioid Data Dashboard is an interactive website that offers information on how opioids are affecting people in Illinois. The dashboard consists of three categories: Morbidity and Mortality, Trends, and Prescription Opioids. Morbidity and Mortality data includes the rate of fatal and non-fatal opioid overdoses by county, as well as the number of overdoses by zip code. Trends look at fatal and non-fatal opioid overdoses by age group, race, sex, and cause (heroin vs. other opioids). Prescription Opioids include data on the rate, by county, of opioids being prescribed, as well as the daily average of opioids being prescribed. It also includes the annual number of total patients being prescribed an opioid and the total number of prescriptions issued.

9. References

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