

Project Part I

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The American Drug Epidemic: An Investigation in Demographic Trends

Introduction

The drug epidemic has been around for decades and continues to worsen in the United States. The United States is struggling with one of its worst drug crises as overdose deaths remain a leading cause of injury-related death in the United States [1]. The majority of overdose deaths involve opioids: More than 1,500 people per week die from opioid related-overdoses [2]. Meanwhile, millions more Americans suffer from an opioid addiction.

The reality of this epidemic can be understood by observing its impact upon individuals. Drug abuse engenders frequent social problems and can be arduous for victims. The damage to cranial nerves caused by taking drugs may cause cognitive disorders and emotional dysregulation, thus leading to problems such as violent crimes and psychological trauma [3]. Moreover, people caught using illegal drugs will face legal consequences that may deprive them of their family, future job opportunities, welfare assistance, public housing, and voting rights. As a result, the discrimination against and stigmatization of drug users further intensifies inter-generational poverty and racial discrimination [4].

While the individual impact of drug overdoses is immense and devastating, there is also an enormous social cost of drug abuse in the United States. Drug overdoses exact a high death toll upon the U.S. population, greatly eroding the base of the labor force. Since 2015, the opioid mortality rate has contributed to a historic decline in life expectancy in the United States [2]. Additionally, the CDC reports that in 2021 more than 100,000 people in the United States died from a drug overdose. This is eight times that of shooting incidents, and is nearly triple the number of deaths which occur in traffic accidents [3]. A social cost also manifests in the price of crime fighting, health care, productivity loss, and drug education

which occurs in an effort to mitigate the drug overdose epidemic. Since 1971, for example, the United States has spent one trillion dollars combating drug-related crimes [3].

The relevance and importance of studying the American drug overdose epidemic cannot be understated. The U.S. drug problem is a long-standing and deep-rooted disease that has not been cured. It is pertinent to complete a thorough investigation of the drug epidemic's impact on the U.S. population in order to draw conclusions on the potential effect drug overdoses have had on the nation in recent years. An exploratory data analysis can also help illuminate which populations are the most at risk, therefore aiding in the focus and allocation of community resources to those that are most in need.

The following questions will be asked as an extension of this research goal: (1) Over the past five years have men had a higher number of overdose deaths than women? Does the comparison between sex assigned at birth change when you observe the proportion of overdose deaths by drug type? (2) In 2021, do non-white populations have a higher rate of drug overdose deaths when compared to white populations? Is any demographic disproportionately affected by drugs in the United States? (3) Did the rate of drug overdose deaths for opioids increase during the COVID-19 pandemic (2020-2021)?

This report will ultimately generate potential significant variables that may be used to combat the drug epidemic in the United States, specifically focusing on potential causes of recent spikes in drug overdoses and social groups that may be at risk.

Description of Data Set

In order to generate the appropriate data set to answer the aforementioned research questions, data was collected from the National Center for Health Statistics (NCHS) and the Centers for Disease Control and Prevention (CDC). Both federal research agencies collect information on deaths involving drugs commonly associated with fatal overdoses. This information was pulled from a searchable database called CDC Wonder [5].

The data available on the CDC Wonder web portal are population data spanning the years 1999-2021. Using publicly stored data, the information is based on death certificates for U.S. residents. Each death certificate contains a single underlying cause of death and demographic data. The number of deaths, crude death rates, age-adjusted death rates, and 95% confidence intervals for death rates can be obtained because of the plethora of accessible information such as cause of death, age, race, gender, and year [5].

The two data sets that have been combined within this report are titled Dem_Drug_Data.csv

and `RawCounts_Drug_Data.csv`. The former is a data set which contains the rate of national drug overdose deaths by demographic. The age-adjusted rates (per 100,000 population) are broken down by type of drug, sex, and race from 1999 to 2021. The latter is a data set which contains the number of national drug overdose deaths involving select prescription and illicit drugs. This population data is the raw count values of the overdose deaths from 1999 to 2021 and the information is distinguished by sex and drug type. When combined, the final data frame is in a wide format. This means that the rows represent unique years of data collection (1999-2021) and the columns represent the drug-type/demographic groups for both raw count and rate data. The final data frame has 23 observations and 78 variables. Both data sets provide a sufficient amount of information to be able to investigate the research questions above because of their attention to drug type and demographic details within each observation aggregated into the summary statistics.

While this data is plentiful and will be used as a foundation for this report, it does not come without limitations. To briefly address this concern, a limitation arises in the lack of raw count data regarding race demographics. While the data sets provide information regarding the raw counts of overdose deaths for men and women, no information is included regarding the race of the victims. This data, however, is purposefully left out in favor of rate data because raw counts can often skew perceptions. The use of rates, rather than raw numbers, is important for comparison among populations since the number of events depends (in part) on the size of the population. Age-adjusted ratios are necessary when determining rates in order to show a more accurate and equitable view of non-white communities in the United States. Showing non-adjusted data can mask disparities, while the rates take into consideration the individual population of race and the age of that population.

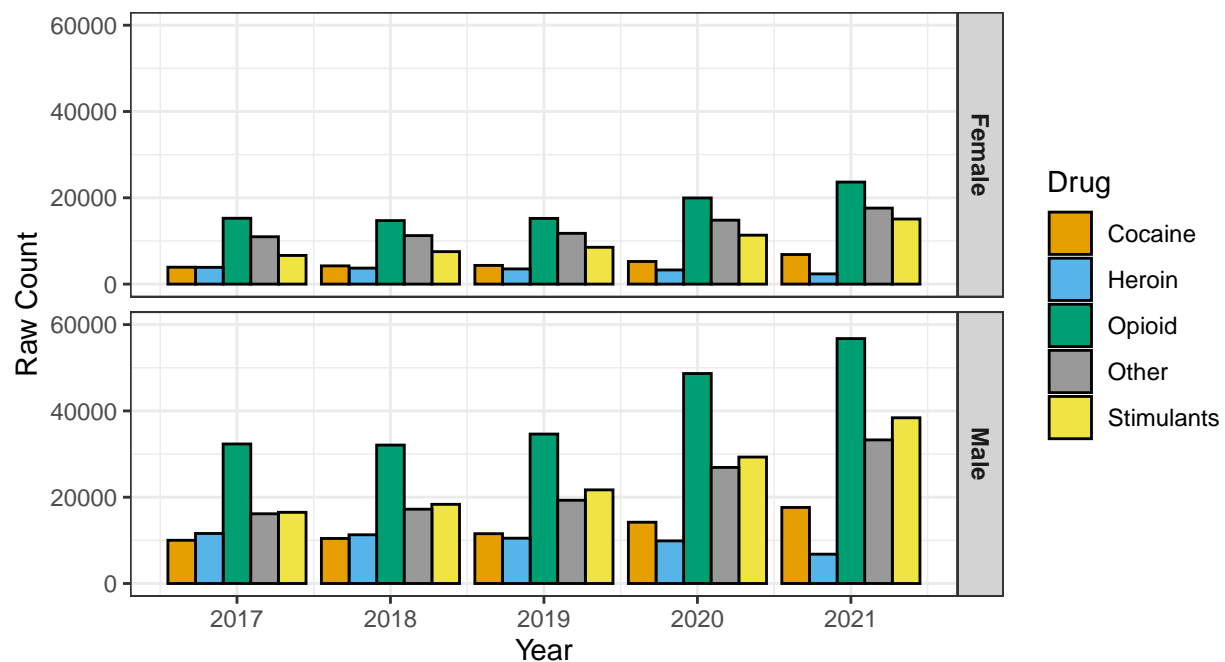
Data Summary

Comparison between Sexes Assigned at Birth

The following two graphs illustrate a comparison between the male and female U.S. population. The first graph details the difference in raw counts between the sexes and type of drug overdoses. The second graph demonstrates the proportional difference between the sexes and type of drug overdoses. Both are used to answer the first research question.

Number of National Drug Overdose Deaths (2017–2021)

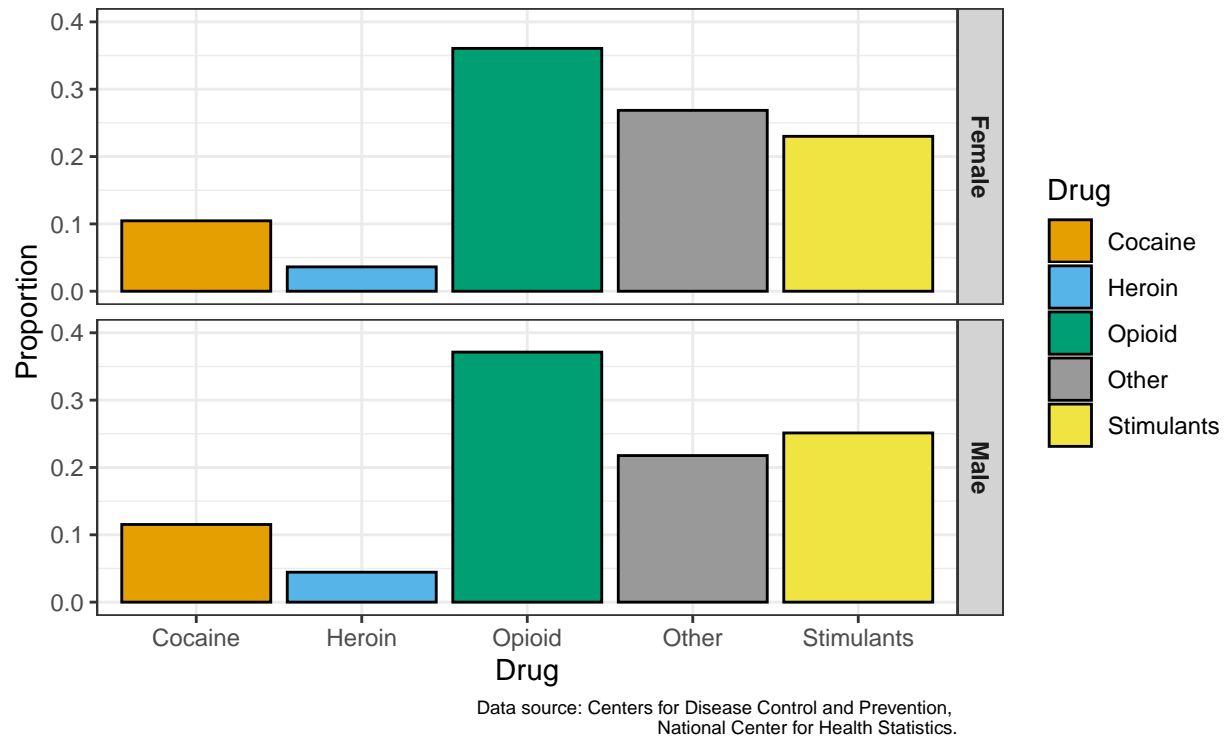
Comparison between total overdose deaths for the biological sexes. Raw counts of overdose deaths are divided between drug category instead of a summation (total overdose deaths). Includes overdose deaths involving select prescription and illicit drugs.



Data source: Centers for Disease Control and Prevention,
National Center for Health Statistics.

Proportion of National Drug Overdose Deaths (2021)

Comparison between total overdose deaths for the biological sexes. Proportions of overdose deaths for each respective sex are divided between drug category. Includes overdose deaths involving select prescription and illicit drugs.



From these two graphs, one can conclude that while men experience higher numbers of overdose deaths than women in the United States, the distribution of deaths between different types of drugs are relatively similar. Opioids stand out as the leader in overdose deaths for both men and women.

Rate of Overdose Deaths Comparison among Race Demographics

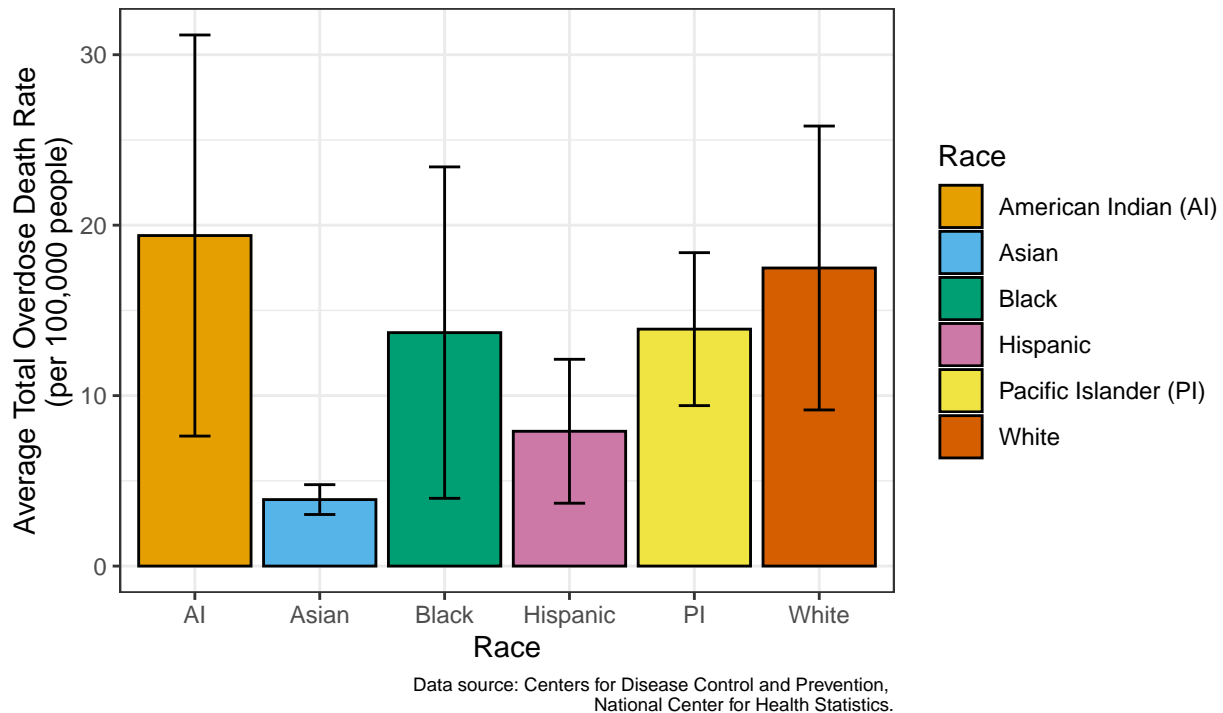
The following numerical summary notes the differences among the mean and standard deviation of the overdose death rates for racial groups. The bar chart with error bars visually depicts this information in order to answer the second research question.

Race	White	Black	Asian	PI	Hispanic	AI
Mean	17.49	13.70	3.90	13.90	7.90	19.39
SD	8.33	9.72	0.88	4.49	4.22	11.77

Table 1: Average Rate of National Drug Overdose Deaths, by Demographic (1999-2021).

Average Rate of National Drug Overdose Deaths by Demographic

Comparison between the average rate of total overdose deaths by race. Error bars represent the standard deviation from the mean calculated for each average. Includes overdose deaths involving select prescription and illicit drugs. Rates are age-adjusted per 100,000 population (1999–2021).



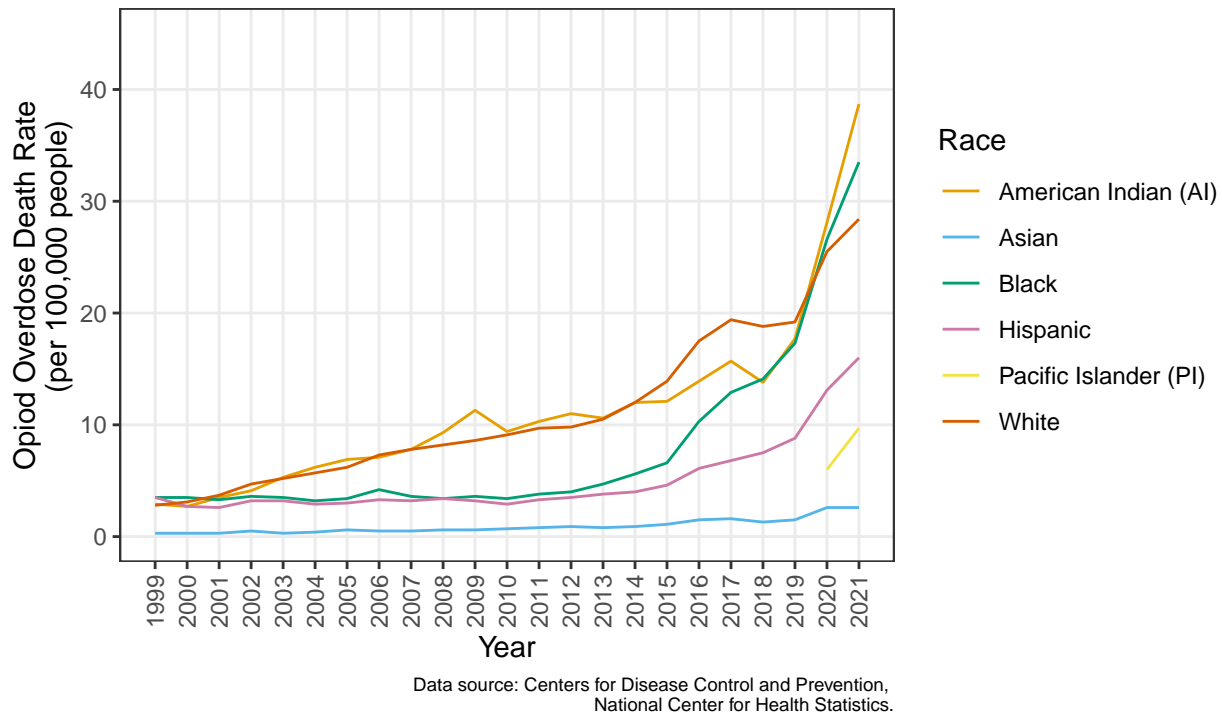
The bar graph above helps illustrate not only the difference in average overdose death rates across racial demographics, but notes the robust variation of rate values in the data set. Larger error bars/standard deviation indicate a larger spread. One can then conclude that the rate data is more variable from the mean and that there has been a large change over time in the rate of overdose deaths in the United States (a large increase over time). One can also glean from the table and chart that the U.S. American Indian population has the greatest average overdose death rate.

Rate of Overdose Deaths for Opioids during Covid-19

The final graph of this report highlights the potential impact Covid-19 had on the drug epidemic in the United States, answering the third research question. Similarly to analyzing the relationship between sex, race, drug type, and rate/count of death, other sources of influence must be acknowledged and addressed such as the global pandemic.

Rate of National Opioid Overdose Deaths by Demographic

Comparison between the average rate of opioid overdose deaths by race. Includes overdose deaths involving select prescription and illicit drugs. Rates are age-adjusted per 100,000 population. Prior to 2018, mortality data for Asian and Pacific Islander populations were combined and is therefore not present in the graph. (1999–2021)



As seen from the previous line chart, an observable increase unlike previous years occurred between 2019-2021. There seems to be a clear relationship between the Covid-19 pandemic and an increase in opioid overdose deaths across all demographic groups. It should be acknowledged that the Pacific Islander group lacks a considerable amount of information because of recent changes in reporting standards, but even with this limitation, the increase is still present.

Conclusion

This EDA report provided many insights into the factors that hold a relationship with drug overdose deaths. While all studied groups have been negatively impacted by the drug epidemic in the U.S., there were observable groups which had a stronger relationship with higher rates/counts of death. The male sex, American Indian demographic, and the opioid drug type all had a considerable demonstrated trend with the data on overdose deaths. The appearance of these characteristics were found alongside a demonstrated increase in drug overdose deaths. With the understanding drawn from this data, the U.S. should face its problem squarely, take actions to deal with the domestic issue of drug abuse, and protect the American people's right to life by specifically targeting the aforementioned variables.

References

1. “Understanding Drug Overdoses and Deaths.” Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 14 Feb. 2022, <https://www.cdc.gov/drugoverdose/epidemic/index.html>.
2. “The U.S. Opioid Epidemic.” Council on Foreign Relations, Council on Foreign Relations, <https://www.cfr.org/backgrounders/us-opioid-epidemic#chapter-title-0-1>.
3. “Drug Abuse in the United States.” Drug Abuse in the United States, Feb. 2023, https://www.fmprc.gov.cn/mfa_eng/wjbxw/202302/t20230209_11022554.html.
4. “Race and the Drug War.” Drug Policy Alliance, <https://drugpolicy.org/issues/race-and-drug-war>.
5. “Multiple Cause of Death 2018-2021 by Single Race.” Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, <https://wonder.cdc.gov/wonder/help/mcd-expanded.html#Frequently%20Asked%20Questions%20about%20Death%20Rates>.

Appendix (Cleaned Data Set and Code)

##	Year	Total_Overdose_Deaths.x	TOD_Female.x	TOD_Male.x	TOD_White	TOD_Black			
## 1	1999	6.1	3.9	8.2	6.2	7.5			
## 2	2000	6.2	4.1	8.3	6.6	7.3			
## 3	2001	6.8	4.6	9.0	7.4	7.6			
## 4	2002	8.2	5.8	10.6	9.2	8.2			
## 5	2003	8.9	6.4	11.5	10.2	8.2			
## 6	2004	9.4	6.9	11.8	11.0	8.3			
##	TOD_Asian	TOD_PI	TOD_Hispanic	TOD_AI	Opioids.x	O_Female.x	O_Male.x	O_White	
## 1	NA	NA	5.4	6.0	2.9	1.4	4.3	2.8	
## 2	NA	NA	4.6	5.5	3.0	1.6	4.4	3.1	
## 3	NA	NA	4.5	6.9	3.3	1.9	4.8	3.7	
## 4	NA	NA	5.4	8.5	4.1	2.6	5.7	4.7	
## 5	NA	NA	5.6	10.8	4.5	2.8	6.1	5.2	
## 6	NA	NA	5.2	12.5	4.7	3.1	6.3	5.7	
##	O_Black	O_Asian	O_PI	O_Hispanic	O_AI	Heroin.x	H_Female.x	H_Male.x	H_White
## 1	3.5	0.3	NA	3.5	2.9	0.7	0.2	1.2	0.7
## 2	3.5	0.3	NA	2.7	2.7	0.7	0.2	1.1	0.6
## 3	3.3	0.3	NA	2.6	3.5	0.6	0.2	1.0	0.6

## 4	3.6	0.5	NA	3.2	4.1	0.7	0.2	1.2	0.7
## 5	3.5	0.3	NA	3.2	5.3	0.7	0.2	1.2	0.7
## 6	3.2	0.4	NA	2.9	6.2	0.6	0.2	1.1	0.7
##	H_Black	H_Asian	H_PI	H_Hispanic	H_AI	Stimulants.x	S_Female.x	S_Male.x	S_White
## 1	0.8	NA	NA	1.1	NA	1.5	0.7	2.3	1.2
## 2	0.9	NA	NA	0.9	NA	1.4	0.7	2.2	1.2
## 3	0.8	NA	NA	0.9	NA	1.5	0.8	2.3	1.3
## 4	0.9	NA	NA	1.0	NA	1.9	1.0	2.8	1.7
## 5	0.8	NA	NA	1.0	NA	2.1	1.1	3.2	2.0
## 6	0.6	NA	NA	0.7	NA	2.3	1.2	3.3	2.2
##	S_Black	S_Asian	S_PI	S_Hispanic	S_AI	Cocaine.x	C_Female.x	C_Male.x	C_White
## 1	3.7	NA	NA	1.8	1.1	1.4	0.6	2.1	1.0
## 2	3.4	NA	NA	1.4	1.2	1.3	0.6	1.9	1.0
## 3	3.6	NA	NA	1.5	1.4	1.3	0.7	2.0	1.0
## 4	4.0	NA	NA	1.8	1.6	1.6	0.8	2.4	1.3
## 5	4.2	NA	NA	1.9	2.4	1.8	0.9	2.7	1.6
## 6	4.4	NA	NA	1.8	2.7	1.9	1.0	2.8	1.7
##	C_Black	C_Asian	C_PI	C_Hispanic	C_AI	Other.x	Other_Female.x	Other_Male.x	
## 1	3.7	NA	NA	1.7	0.9	0.2	0.1	0.3	
## 2	3.3	NA	NA	1.3	1.0	0.2	0.1	0.3	
## 3	3.6	0.2	NA	1.3	1.0	0.2	0.1	0.3	
## 4	4.0	0.2	NA	1.5	1.1	0.3	0.2	0.5	
## 5	4.1	0.2	NA	1.6	1.7	0.4	0.2	0.6	
## 6	4.3	0.2	NA	1.4	1.6	0.4	0.3	0.6	
##	Other_White	Other_Black	Other_Asian	Other_PI	Other_Hispanic	Other_AI			
## 1	0.2		0.1		NA	NA	0.2	NA	
## 2	0.2		NA		NA	NA	0.2	NA	
## 3	0.2		NA		0.2	NA	0.2	NA	
## 4	0.4		0.1		0.2	NA	0.3	NA	
## 5	0.5		0.1		0.3	NA	0.4	NA	
## 6	0.5		0.1		0.2	NA	0.4	1.3	
##	Total_Overdose_Deaths.y	TOD_Female.y	TOD_Male.y	Opioids.y	O_Female.y	O_Male.y			
## 1		16849	5591	11258	8050	2057	5993		
## 2		17415	5852	11563	8407	2264	6143		
## 3		19394	6736	12658	9496	2767	6729		
## 4		23518	8490	15028	11920	3760	8160		

## 5		25785	9386	16399	12940	4138	8802			
## 6		27424	10304	17120	13756	4643	9113			
##	Heroin.y	H_Female.y	H_Male.y	Stimulants.y	S_Female.y	S_Male.y	Cocaine.y			
## 1	1960	306	1654	4271	980	3291	3822			
## 2	1842	279	1563	4017	980	3037	3544			
## 3	1779	313	1466	4308	1083	3225	3833			
## 4	2089	359	1730	5423	1400	4023	4599			
## 5	2080	358	1722	6215	1626	4589	5199			
## 6	1878	341	1537	6591	1767	4824	5443			
##	C_Female.y	C_Male.y	Other.y	Other_Female.y	Other_Male.y	X	X.1	X.2	X.3	X.4
## 1	850	2972	3431	1504	1927	NA	NA	NA	NA	NA
## 2	843	2701	3674	1628	2046	NA	NA	NA	NA	NA
## 3	957	2876	4174	1775	2399	NA	NA	NA	NA	NA
## 4	1143	3456	5333	2366	2967	NA	NA	NA	NA	NA
## 5	1322	3877	5939	2622	3317	NA	NA	NA	NA	NA
## 6	1405	4038	6690	3021	3669	NA	NA	NA	NA	NA