Overdose Deaths in Connecticut by Race, Gender, and Age

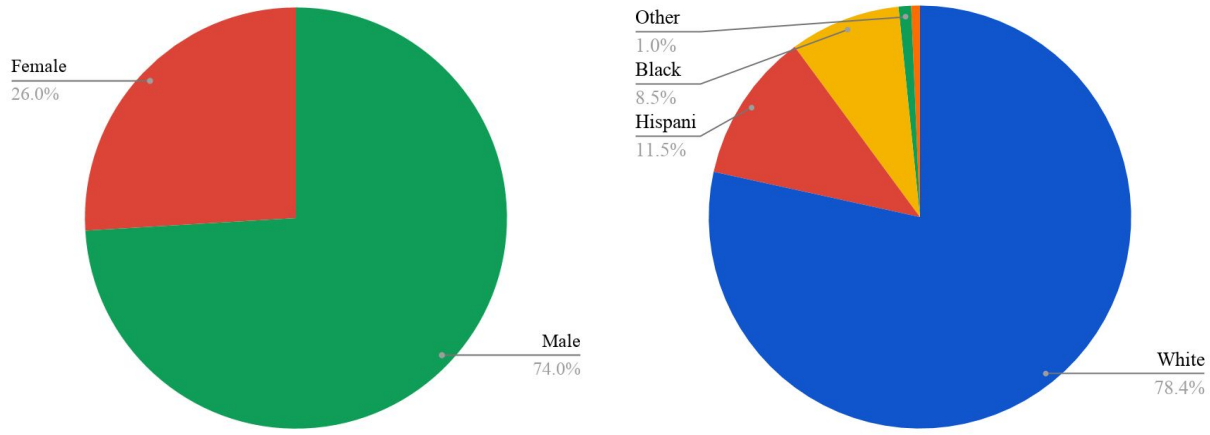
Data provided by the State of Connecticut

Rochester Institute of Technology - Fall 2019

ECON403 - Econometrics I - Will Clifford

Introduction

In this paper, I intend to explore the relationships between race, gender, age, and drug use in individuals who died of an overdose. Specifically, I intend to determine the following relationships: (1) if some races, genders, or drugs of choice impact the age of death and (2) if race, gender, or age are significant in determining the likelihood of someone overdosing on a specific drug. I anticipate linear relationships, but will be interacting boolean variables to see if specific gender/race groups show different behavior.



Figures 1 & 2 - Gender and Race Breakdowns

Overview of Data

Overdose fatality data were provided by the State of Connecticut via Data.gov[1] (accessed 1/16/2020). I added booleans for each of the races and added the NumDrugs column. I combined the variables for Native American, Hawaiian, Unknown, Other, and blank entries into one Other variable.

[1] https://data.ct.gov/Health-and-Human-Services/Accidental-Drug-Related-Deaths-2012-2018/rybz-nyjw

I examine five kinds of variables in the data. The first is the victim's age at death, Age, measured in years. The second is a gender boolean, Female, that indicates whether or not the overdose victim is female. The following five variables, Black, White, Hispanic, Asian, and Unknown/Other, are boolean variables indicating the victim's race. The next fifteen variables are also booleans, one for each of the drugs detected in the victim's body after death. The last is NumDrugs, which is the sum of the drug variables. This variable indicates the number of different drugs detected in the victim's body after death.

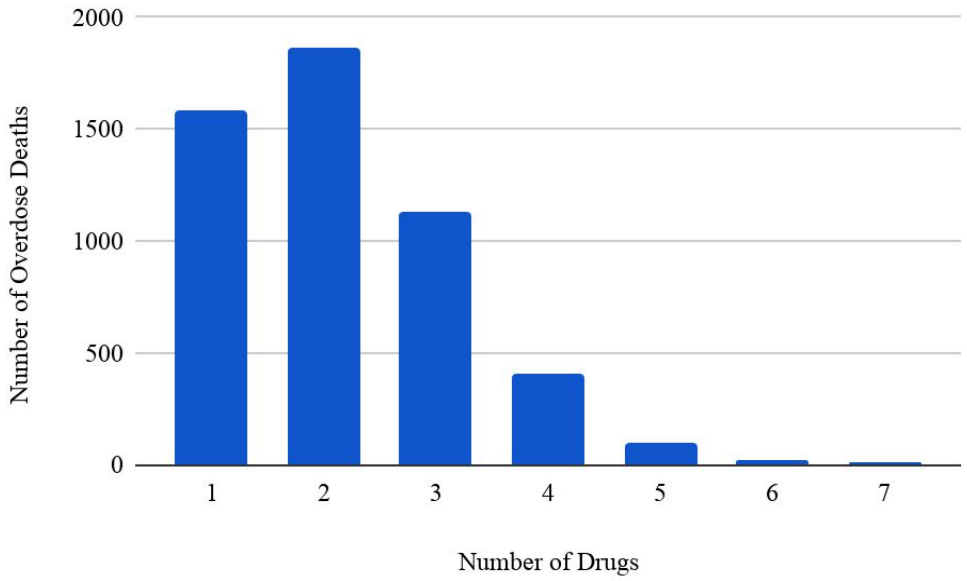


Figure 3 - Number of Drugs used by Overdose Victims

Five drugs were the most involved in overdose deaths in this sample. These were Heroin (49.5%), Fentanyl (43.6%), Cocaine (29.8%), Benzodiazepine (26.3%), Ethanol (Alcohol) (24.4%). Nearly all other drugs in the sample were involved in fewer than 10% of overdoses. The mode number of different drugs in an overdose was 2, making up over 35%

of reported overdose deaths in the sample. A plot of this distribution (Figure 3) shows a strong leftward skew towards 1 to 3 drugs.

Predictions

I anticipate significantly decreased lifespan for fentanyl and heroin users by comparison to other drugs, due to their prevalence and potency. I don't anticipate race having an effect on age of death, and I don't anticipate any significant interaction between gender, race, and age of death. As age increases, I predict NumDrugs will decrease, because substance abusers who use only one drug at a time may be less likely to die of a drug "cocktail." From my personal biases, I would predict males use more different drugs at once than women, and I predict higher lifespans for women than men.

Overview of Models

My first model examined the linear effect of gender, race, and drug of choice on the age of overdose victims. This model takes Age as the dependent variable and Gender, Race, and Drugs are independent variables. Since all records in the sample were fatalities, I interpreted age as lifespan of those people who die of overdose. This makes sense intuitively, and we can see if a substance abuser is predicted to die earlier depending on demographic data or if certain drugs appear more deadly than others. I also examined a modified model that included interaction variables between race and gender.

Many victims were found with more than one drug in their system. I introduced a new variable *NumDrugs* that counts up the number of different drugs were detected in

each victim's blood after their death. With this in mind, I sought to examine whether some demographic groups were more likely to mix multiple drugs than others. To that end, the third model takes NumDrugs as the dependent variable and Gender, Race, and Age are independent variables. Here, since NumDrugs is linearly dependent on the Drug variables, it is impossible to include (or interpret) them in this model. As with the first model, I examined a modified version of this model with Race/Gender interaction variables included.

The predictions in the above section can be phrased in terms of these models in the following way: in the first model, negative parameter estimates for the Fentanyl and Heroin, statistically insignificant race variables, statistically insignificant or small values for the parameter estimates for interaction variables of race and gender, and a positive parameter estimate for Female. In the second model, a negative parameter estimate for age, and a negative parameter estimate for female.

Results

In the first model, there are fifteen highly significant variables. The intercept indicated that a white male who overdosed on heroin is predicted to have died at 39.7 years old. Three race variables were statistically significant - Black and Hispanic victims are predicted to live 5.1 and 1.6 years longer than white victims, while Asian victims are expected to live 6.3 years fewer than white victims. Eleven drug variables were statistically significant. People who overdosed on Amphetamines and Fentanyl were predicted to live 2.5 and 2.1 fewer years, respectively. Individuals who overdosed on the other statistically

significant drugs (Benzodiazepine, Cocaine, Ethanol, Methadone, Oxycodone, Morphine, Hydrocodone, Tramadol, Hydromorphone) were predicted to live between 1.4 and 6.8 years longer than the intercept drug, heroin. As predicted, the modified model that interacts race and gender had no statistical significance.

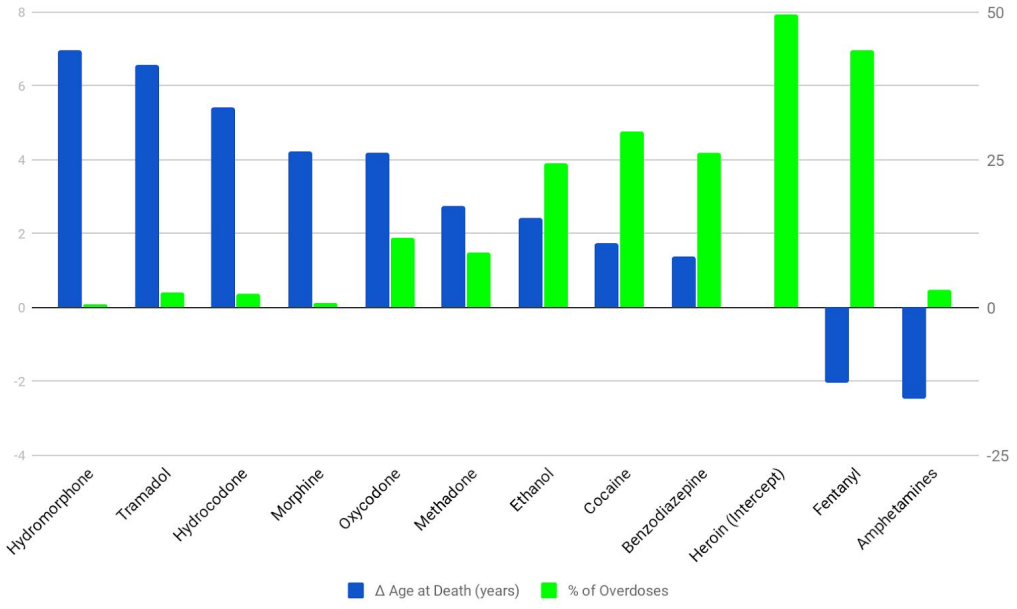


Figure 4 - Drugs by Age at Death and Involvement in Overdoses

When plotted as in Figure 4, there appears to be a rough trend suggesting that as drugs are involved in higher percentages of overdoses, they typically have younger victims. With this relationship in mind, I grouped the drugs in the following way:

- **A.** Hydromorphone, Tramadol, Hydrocodone, Morphine, Oxycodone, Methadone
- **B.** Ethanol (Alcohol), Cocaine, Benzos
- **C.** Heroin, Fentanyl
- **D.** Amphetamines

Group A drugs are all opiates that are involved in the fewest overdoses. Victims of Group A drugs tend to die at older ages. Group B drugs are involved in 25% of overdoses each, and are common recreational drugs - alcohol, cocaine, and sedatives like Xanax and Valium. Group C drugs are involved in around 50% of overdoses, and consist of the more deadly opioids heroin and fentanyl. Amphetamines are an outlier, as they are responsible for a low number of overdoses, but victims are predicted to die at younger ages than any other statistically significant drugs. This makes more sense, however, when considering the variability between amphetamines. Amphetamines often refer to unpredictable, hard drugs like Meth and MDMA, but also includes commonly prescribed medications like Adderall for ADHD and Wellbutrin for depression.

Upon revisiting the second model, I considered the possibility of the age term being non-linear, and examined a new model with an Age^2 term. The turning point for the new model is 44.8 years old, and 41.5% of the sample victims were older than that. At this turning point age of ~45 years old, victims are predicted to test positive for 1.06 more drugs than the intercept. A simple demonstration of this is the following: an 18-year-old overdose victim is predicted to test positive for 1.9 different drugs, while a 45-year-old would test positive for 2.3 drugs. A 92-year-old overdose victim is predicted to test positive for 1.2 drugs. A quadratic model clearly fits the data better and provides more information than a linear model can provide.

The first model agreed with my predictions for lower life expectancy for overdose victims of heroin and fentanyl, though I had not predicted amphetamines to be as lethal as the model predicted. All race variables except Other/Unknown were at least somewhat

statistically significant, contradicting my initial prediction. As predicted, the interaction variables between gender and race had little to no statistical significance in either model. The female variable was statistically insignificant, contradicting my prediction of a positive parameter estimate. My predictions on the effect of age on number of drugs were incorrect, as I had only hypothesised linear relationships.

Conclusion

In determining age at death in overdose victims, race and type of drug are predicted to be statistically significant. The "average" case is a 39.7-year-old white male who overdosed on heroin. Black and Hispanic overdose victims are predicted to live 5.1 and 1.6 years longer than white victims, respectively, while victims of other races are predicted to live 1.6 years fewer than their white counterparts. Victims who test positive for Hydromorphone are perhaps the best off of all the other drugs, and are predicted to live nearly 7 years longer than those who overdosed on Heroin. The following drugs are all also significant and positively associated with age relative to Heroin: Tramadol (6.6y older), Hydrocodone (5.4y), Morphine (4.3y), Oxycodone (4.2y), Methadone(2.7y), Ethanol (2.4y), Cocaine (1.7y), and Benzodiazepine (1.4y). Only two drugs that were negatively associated with age relative to heroin - Fentanyl and Amphetamines, whose victims were expected to live 2.1 and 2.5 fewer years, respectively. In determining the number of drugs in an overdose victim, race and age are significant. Black and Hispanic victims are predicted to overdose on 0.13 and 0.08 fewer drugs than white victims, respectively. Between 0-years-old and approximately 45-years-old, increased age is correlated with increase in

number of drugs. The maximum indicates that a 45-year-old white male overdose victim is predicted to test positive for 2.3 drugs. From 45-years-old on, the number of drugs is predicted to decrease as age increases.

Black and Hispanic victims are predicted to overdose later in life than white victims, and Asian victims are predicted to overdose over 6 years earlier than white victims. My first attempt to explain this change in age at death was to look at poverty rates by race, however these rates have no clear association with the change in expected age at time of death[2]. In a similar econometric study of Connecticut's overdose statistics, assistant professor of medicine at Yale University Dr. Daniel Tobin offers the following explaination, "Being white or affluent doesn't protect you. In fact, in some cases it might be a risk factor. Affluent communities tend to have better access to prescription pain medications.[3]"

Perhaps the most surprising of these results is the lack of significance of gender. Physically, I predicted that increased body weight could lower males' chances of death as fatal doses of most drugs are dependent on body weight. This could be tested by including body weight of victims in future samples. Sociologically, however, I am inclined to generalize male drug users between the ages of 18 and 45 as more impulsive than their female counterparts - and therefore more likely to use more drugs at once or to use too many and overdose earlier in life. The relationship between biological sex, impulse, and drug use is complex and well-documented[4], though the models I observe here have nothing concrete to contribute to these discussions.

[2] https://talkpoverty.org/state-year-report/connecticut-2018-report/
[3] https://overdose.trendct.org/story/who
[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012004/