



# COVID-19's impact on drug overdose fatalities and urgent mental health care demand in the US

Izuru Inose<sup>1</sup> · Yoshiyasu Takefuji<sup>1</sup>

Received: 1 March 2024 / Accepted: 22 April 2024

© The Author(s) under exclusive licence to International Union for Physical and Engineering Sciences in Medicine (IUPESM) 2024

## Abstract

**Purpose** The purpose of this study is to scrutinize the repercussions of the COVID-19 pandemic on the incidence of drug overdose fatalities in the US.

**Methods** The study utilizes datasets from the CDC and employs a linear regression model to calculate the time-series of excessive deaths spanning from 2020 to 2022. An extensive literature review focusing on overdoses during the pandemic period is also conducted.

**Results** The findings reveal that the influence of COVID-19 on overdose fatalities in 2020, 2021, and 2022 were 1.18, 1.36, and 1.38 times higher, respectively. The observed demand for urgent mental health care has seen a lesser decline compared to the overall need for emergency services.

**Conclusions** This study offers critical insights into the correlation between the COVID-19 pandemic and drug overdose deaths in the US, which could serve as a valuable resource for future research and policy-making decisions. Consequently, it is imperative for emergency departments to be equipped and ready to deliver crucial care for adolescents confronted with mental health crises.

**Keywords** COVID-19 impact · Drug overdose deaths · Excessive deaths

## 1 Introduction

This paper challenges and analyzes the impact of COVID-19 on drug overdose deaths in the US from 2014 to 2022. To calculate excessive deaths due to COVID-19, a new Python Package Index (PyPI) application has been created. CDC released two datasets on April 5, 2022 and August 23, 2023 respectively. These datasets include Monthly Counts of Deaths by Select Causes (2014–2019) and (2020–2023).

Data from 2014 to 2019 are used to predict excessive deaths in 2020, 2021 and 2022 respectively. The newly created covidimpact tool calculates the excessive deaths, impact of COVID-19 and R-squared value. The excessive death is calculated by subtracting the predicted value from

the actual death data. The impact of COVID-19 is calculated by dividing the actual deaths by the predicted deaths. R-squared is a statistical measure in a regression model that determines the proportion of variance in the dependent variable that can be explained by the independent variable. In other words, r-squared shows how well the data fit the regression model. A higher R-squared value generally indicates a better fit of the model to the data.

A literature review was conducted on drug overdose during the COVID-19 pandemic. Romero et al. found that from 2010 to 2021, the overdose rates among Hispanics in the US increased from 5.6 to 21.7 per 100,000, representing a 287.5% increase [1]. In comparison, the overdose rates among non-Hispanics increased from 13.5 to 35.1 per 100,000, representing a 160% increase. The average annual percent change was 12% for Hispanics and 9% for non-Hispanics. The three most common drug classes involved in overdose deaths among both groups were Fentanyl and synthetic opioids, cocaine, and prescription opioids.

Schiller et al. investigated opioid overdose [2]. The opioid epidemic has led to a focus on finding effective interventions and identifying risk factors for overdose. Research

✉ Yoshiyasu Takefuji  
takefuji@keio.jp

Izuru Inose  
s2122005@stu.musashino-u.ac.jp

<sup>1</sup> Faculty of Data Science, Musashino University, 3-3-3 Ariake Koto-ku, Tokyo 135-8181, Japan

suggests that overdose education and naloxone distribution can reduce fatalities. Naloxone has a safe side effect profile but can cause acute withdrawal symptoms in opioid-tolerant patients. These symptoms are usually not severe and less than 1% of patients require admission.

A state-level analysis of epidemiological data on overdose mortality in the US in 2020 found that males had greater overall overdose mortality than females for synthetic opioids, heroin, psychostimulants, and cocaine, after controlling for rates of drug misuse [3]. The sex difference generally survived adjustment across 10-year age bins, especially in the 25–64 age range. These results call for research into diverse factors that underlie sex differences in vulnerability to drug overdose.

Jarlais et al. found that in a study of people who inject drugs, 71% were male, with a mean age of 49 [4]. Heroin was the most frequently reported drug used, and 82% were fentanyl positive. 60% had overdosed in their lifetime, and 34% during the COVID-19 pandemic. Previous overdose, psychiatric diagnosis, and having a regular group of injectors were associated with experiencing an overdose during the pandemic. Overdose coping strategies were generally not associated with a lower probability of experiencing an overdose.

van Draanen et al. conducted a literature review and found that after screening 6512 records, 38 studies were selected for inclusion in this review [5]. Of these, 37 studies found a connection between at least one aspect of mental disorder and opioid overdose. The strongest evidence exists for internalizing disorders, particularly mood disorders, followed by anxiety disorders. Moderate evidence also supports the relationship between thought disorders, such as schizophrenia and bipolar disorder, and opioid overdose. Additionally, moderate evidence was found for the association between any disorder and overdose.

Workman et al. reported that COVID-19 risk mitigation efforts during the pandemic may have worsened anxiety, depression, and substance use among adolescents and young adults [6]. Their study analyzing emergency department visits found increased overdose, anxiety, and depression rates during COVID-19. Anxiety and depression were linked to higher odds of overdose. Addressing mental health in primary care is crucial. Villas-Boas et al. concluded that during the COVID-19 pandemic, adolescent emergency department (ED) visits, especially for mental health (MH), dropped but rebounded faster than overall ED visits [7]. They suggested that the perceived need for emergent MH care decreased less than the overall need for emergency care. Therefore, EDs should be prepared to provide critical care for adolescents facing MH emergencies.

The literature review results suggested that during the COVID-19 pandemic, drug overdose rates increased,

especially among Hispanics. Overdose education and naloxone distribution can reduce fatalities. Males had higher overdose mortality than females. People who inject drugs, particularly males and those with a psychiatric diagnosis, had high overdose rates. Mental disorders are linked to opioid overdose. The pandemic may have worsened mental health issues among adolescents and young adults, increasing overdose rates. Emergency departments should be prepared for mental health emergencies.

## 2 Method

Two CDC datasets include Monthly Counts of Deaths by Select Causes (2014–2019) and Monthly Provisional Counts of Deaths by Select Causes (2020–2023) for this study. In the combined dataset from 2014 to 2023, there are 18 select causes such as ‘Drug Overdose’. The dataset, which is based on monthly data, has been converted into annual data for analysis.

The covidimpact tool allows users to select one of 18 causes to display a time-series count of deaths from 2014 to 2022. It is a PyPI application that runs on Windows, MacOS, and Linux operating systems, if Python is installed on the system.

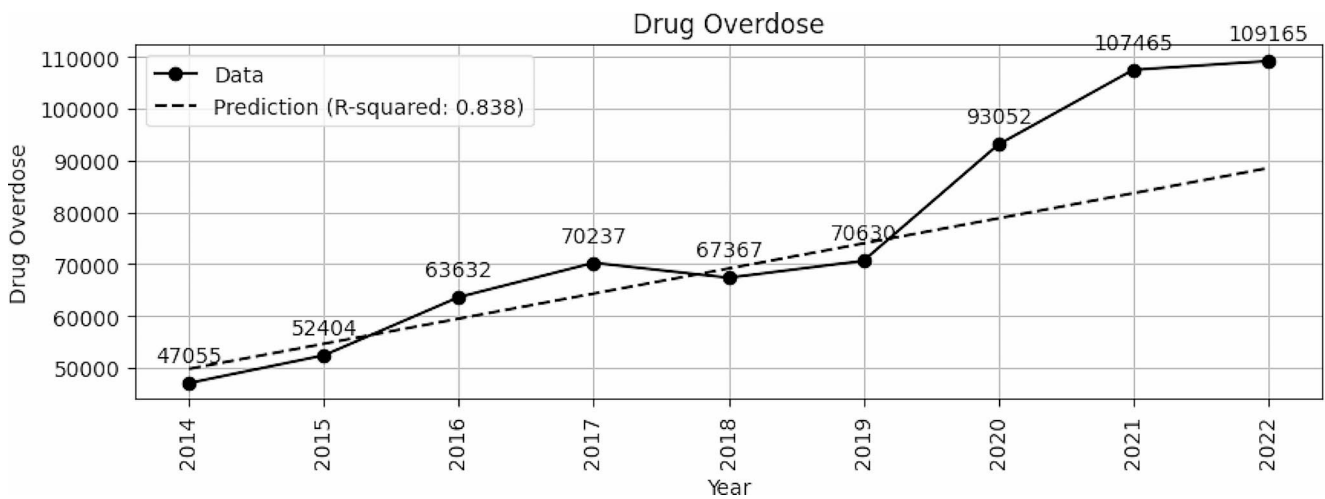
To run covidimpact, simply install it by pip command such as “pip install covidimpact” in the terminal after installing Python on the system. Two datasets are downloaded automatically over the Internet and calculated linear regression line and excessive deaths are shown in the graph with the covidimpact tool.

Excessive deaths are calculated using a linear regression model, with data from 2014 to 2019 used for training the model. The model is then used to estimate the number of overdose deaths in 2020, 2021, and 2022. The R-squared value indicates the tendency of the data to fit the model. Excessive deaths are calculated by subtracting the predicted numbers from the actual numbers. The impact of COVID-19 is calculated by dividing the actual number of deaths by the predicted number.

## 3 Results and discussion

Figure 1 displays the time-series data of drug overdoses from 2014 to 2022. The graph in Fig. 1 includes two lines: a solid line representing the actual data and a dotted line representing a linear regression model using data from 2014 to 2019. The R-squared value of the model is 0.838, indicating a strong correlation between the model and the data.

The results of the impact and excessive deaths in 2020, 2021, and 2022 are as follows: impact:1.18, excessive



**Fig. 1** Drug overdose deaths from 2014 to 2022 with linear regression line

deaths: 14,228 in 2020, impact: 1.36, excessive deaths: 28,641 in 2021, and impact: 1.38, excessive deaths: 30,341 in 2022.

According to the result, the impact, and excessive deaths in 2022 were the largest among the three years, with an impact of 1.38 and 30,341 excessive deaths. This paper uncovers a significant increase in drug overdose death counts, which are notably impacted by and contribute to the excess mortality due to COVID-19. These findings offer valuable insights into the correlation between drug overdoses and COVID-19, serving as a crucial resource for future research and policy-making decisions.

Despite the R-squared value of 0.838 from 2014 to 2019 suggesting a robust fit, it's more informative to segment the period from 2014 to 2022 into three distinct phases: an exponential growth phase up to 2016, a plateau from 2017 to 2019, and a resurgence after 2020. This paper conducted linear regression analysis instead of exponential analysis due to high R-squared fitting rate.

According to the CDC document [8] and the study by Jalal et al. [9] on the opioid overdose epidemic, there was an exponential growth period from 2014 to 2016. In response, the administration declared a 'public health emergency' in October 2017 and enacted comprehensive opioid control legislation [10], which garnered bipartisan support. These measures proved effective, leading to a stabilization in the number of opioid-related deaths between 2017 and 2019, a period marked by a plateau in the death rate as shown in Fig. 1. However, following the spread of COVID-19 after 2020, there was a resurgence in opioid-related fatalities.

The decrease in the perceived need for immediate mental health care has been less pronounced than the drug overall decrease in emergency care needs. As a result, it is essential that emergency departments are prepared and capable

of providing vital care to adolescents experiencing mental health emergencies.

This study critically examined the impact of COVID-19 on drug overdose deaths in the US from 2014 to 2022, using a newly created Python Package Index (PyPI) application to calculate excessive deaths. The CDC released two datasets on April 5, 2022, and August 23, 2023, respectively, which include Monthly Counts of Deaths by Select Causes from 2014 to 2023. Data from 2014 to 2019 are used to predict excessive deaths in 2020, 2021, and 2022. The covidimpact tool calculates excessive deaths, the impact of COVID-19, and the R-squared value. A literature review was conducted on drug overdose during the COVID-19 pandemic, with various studies revealing significant findings about overdose rates, the opioid epidemic, sex differences in overdose mortality, and the connection between mental disorders and opioid overdose. The study concludes that COVID-19 risk mitigation efforts during the pandemic may have exacerbated anxiety, depression, and substance use among adolescents.

**Authors contributions** I wrote the program, visualized and validated the results. YT wrote this article, validated the results and supervised this research.

**Funding** This research has no fund.

**Data availability** Data is available in public.

**Code availability** The Python code is available in public.

## Declarations

**Ethics approval and consent to participate** Not applicable.

**Consent for publication** The authors agree to publish the manuscript.

**Conflicts of interest** The authors have no conflict of interest.

**Highlights** COVID-19 significantly impacted drug overdose deaths from 2020 to 2022.

Largest impact and excessive deaths with drug overdose occurred in 2022.

Impacts of COVID-19 on overdose deaths in 2020, 2021, and 2022 were 1.18, 1.36, 1.38.

Urgent mental health care demand remains high; readiness is crucial.

## References

- Romero R, Friedman JR, Goodman-Meza D, Shover CL. US drug overdose mortality rose faster among hispanics than non-hispanics from 2010 to 2021. *Drug Alcohol Depend.* 2023;246:109859. <https://doi.org/10.1016/j.drugalcdep.2023.109859> (2023).
- Schiller EY, Goyal A, Mechanic OJ, Opioid Overdose. [Updated 2023 Jul 21]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. <https://www.ncbi.nlm.nih.gov/books/NBK470415/> (2023).
- Butelman E, et al. Overdose mortality rates for opioids and stimulant drugs are substantially higher in men than in women: state-level analysis(link is external). *Neuropsychopharmacology.* 2023. <https://doi.org/10.1038/s41386-023-01601-8>.
- Jarlais DD, Weng CA, Feelemyer J, McKnight C. Non-fatal drug overdose among persons who inject drugs during first two years of the COVID-19 pandemic in New York City: prevalence, risk factors. *Drug Alcohol Depend Rep.* 2023;8:100171. <https://doi.org/10.1016/j.dadr.2023.100171>.
- van Draanen J, Tsang C, Mitra S, Phuong V, Murakami A, Karamouzian M, Richardson L. Mental Disorder and opioid overdose: a systematic review. *Soc Psychiatry Psychiatr Epidemiol.* 2022;57(4):647–71. <https://doi.org/10.1007/s00127-021-02199-2>.
- Workman J, Reese JM, Sobalvarro S, Caberto AJ, Garcia J, Cepeda JA. Association between co-occurring anxiety and Depression with Drug Overdose encounters in the Emergency Department among adolescents and young adults in the era of COVID-19. *J Adolesc Health.* 2023;72(6):989–92. Epub 2023 Jan 19. PMID: 36872116; PMCID: PMC9850858.
- Villas-Boas SB, Kaplan S, White JS, Hsia RY. Adolescent total and Mental Health-Related Emergency Department visits during the COVID-19 pandemic. *JAMA Netw Open.* 2023;6(10):e2336463. <https://doi.org/10.1001/jamanetworkopen.2023.36463>. PMID: 37796500; PMCID: PMC10556969.
- CDC.GOV. Understanding the Opioid Overdose Epidemic. Accessed on March 28. 2024. <https://www.cdc.gov/opioids/basics/epidemic.html>.
- Jalal H, Buchanich JM, Roberts MS, Balmert LC, Zhang K, Burke DS. Changing dynamics of the drug overdose epidemic in the United States from 1979 through 2016. *Science.* 2018;361(6408):eaau1184. <https://doi.org/10.1126/science.aau1184>.
- CONGRESS.GOV. Substance Use-Disorder Prevention that promotes opioid recovery and treatment for patients and communities Act or the SUPPORT for patients and communities Act <https://www.congress.gov/bill/115th-congress/house-bill/6>.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.