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US Drug Overdose Mortality: 2009–2018 Increases Affect Young People Who Use Drugs

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Abstract

Purpose: Drug overdose mortality remains a public health concern in many countries globally. In the US, overdoses involving synthetic opioids are the primary contributor to overdose mortality. We aimed to assess trends in overdose death due to synthetic opioids among young people and describe key demographic and temporal changes.

Methods: Data from the US National Vital Statistics System Multiple Cause of Death files for 2009–2018 were analysed to determine age-specific overdose death rates by region (i.e. east versus west of the Mississippi River). Age-adjusted overdose mortality rates were used to compare demographic differences in all drug and synthetic opioid overdose among young people (aged 15–34 years) using a joinpoint regression with Poisson-approximated standard errors.

Results: Driven by synthetic opioid overdose, the age burden of mortality shifted towards young people in eastern states and remained approximately constant in western states over the study

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period. The highest increases in drug overdose mortality rates were observed in young Black and Hispanic people and those living in large metropolitan areas.

Conclusions: Rapid changes in the demographics of overdose demonstrate distinct but overlapping US overdose sub-epidemics, and highlight the need for targeted interventions to reduce overdose risk in young people.

Keywords

Overdose; Substance Use; Harm Reduction; Young People; Fentanyl; Opioids

Introduction

Drug overdose remains a leading cause of death in the United States (US) (Wilson et al., 2020). In what was once considered a prescription opioid and heroin epidemic, overdose mortality involving synthetic opioids other than methadone (hereafter “synthetic opioids”), particularly fentanyl and related analogues, is now a widespread public health concern (Ciccarone, 2019). Contamination of heroin and other drugs with illicitly manufactured fentanyl (IMF) has led to increased mortality, especially in the eastern US, western Canada, and some European countries (Strang et al., 2019; Wilson et al., 2020). Geographic differences in US mortality are likely driven by variation in regional drug supply: white powder heroin—the dominant type of heroin in states east of the Mississippi River, a body of water stretching from near the Great Lakes to the Gulf of Mexico—is more susceptible to undetected adulteration with fentanyl, and therefore represents a greater mortality risk (Gladden et al., 2016; Zoorob, 2019).

As overdose deaths have reached crisis levels, efforts to mitigate overdose mortality, such as prescription drug monitoring programs, overdose education and naloxone distribution, improvements in post-overdose care, and access to medications for opioid use disorder have been rapidly expanded (US Department of Health and Human Services, 2018). Some success in reducing drug overdose mortality in 2018 supports implementation of these policies, particularly for deaths associated with prescription opioids and heroin (Wilson et al., 2020). However, 2018 deaths involving synthetic opioids increased by 10% compared to 2017, likely driven by IMF (Wilson et al., 2020).

Concomitant with the regional expansion of synthetic opioid overdose mortality has been an increase in overdose mortality among young people (i.e. aged 15–34 years) (Wilson et al., 2020), who face a unique set of sociodemographic, psychosocial, psychiatric, and substance use-related risk factors for overdose (Lyons et al., 2019). Using national mortality data, this study analyses this expansion in overdose mortality among young people associated with the evolution of the US overdose crisis over the last 10 years.

Methods

This study aims to analyse how changes in all drug and synthetic opioid-involved overdoses from 2009 to 2018 affected young adults in the US. Young adults were defined as aged 15–34 years. This age category was chosen *a priori*, taking into account the risk factors faced by

younger people (Lyons et al., 2019), and conforming to the standard CDC groupings of 10-year age groups. Mortality data were acquired from Multiple Cause of Death (MCD) mortality files produced by the National Vital Statistics System for the period 2009–2018. These data are obtained from all death certificates in the US and report underlying and additional causes of death, alongside standardised demographic characteristics including age, gender, race, ethnicity, and urbanicity. Urbanicity was classified using the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties data and was aggregated into three categories: Large Metro (comprised of “Large Central Metro” and “Large Fringe Metro”), Small-Medium Metro (“Medium Metro” and “Small Metro”), and Rural-Nonmetro (“Micropolitan” and “Noncore”). In line with data detailing differences in IMF-contaminated drug supply across the US (Zoorob, 2019) and associated increases in synthetic opioid deaths (Gladden et al., 2016), states were categorised as eastern or western as delineated by the Mississippi River. Allocation of states is further detailed in Supplementary Information.

To mitigate misclassifications in postmortem coding and best estimate the true overdose burden across the United States, individuals with an underlying cause of death reported as any drug poisoning (International Classification of Diseases, 10th edition (ICD-10) codes X40–X44, X60–X64, X85, Y10–Y14) were included in the study. MCD files also detail the results of a toxicology panel as additional causes of death. Drug poisonings reporting ‘synthetic opioids other than methadone’ (ICD-10 code T40.4) as an additional cause were analysed separately in this study. To address potential biases in the testing and reporting of synthetic opioids during postmortem procedures that may affect overdose death surveillance (Ruhm, 2017; Slavova et al., 2019), a sensitivity analysis excluded states with a high degree of under-reporting drug-specific overdose deaths (PA, IN, LA, and AL), as conducted previously (Cerdá et al., 2020). Comparison data for older adults and mortality trends by US Census Division were also analysed (see Supplementary Materials).

This study was not considered human subject research due to the anonymised data analysis of deceased individuals; therefore, institutional review board approval was not required.

Statistical analysis

Population census data provided in the MCD data were used to calculate age-adjusted and age-specific mortality rates. Mortality rates were calculated per 100,000 persons and age-adjusted by the direct method; age-specific rates were calculated as crude rates. Statistical analyses were performed using joinpoint regression to estimate annual percentage change in age-adjusted mortality rate (Kim et al., 2000). Mortality rates were considered to be significant if annual percentage changes were statistically different from zero with a *p*-value of <0.05. Standard errors and 95% confidence intervals were calculated using a Poisson distribution.

Results

Overdose mortality involving any drug increased substantially across all ages in eastern states over the study period, with marked increases from 2014 to 2017, while increases in western states remained relatively stable (Figure 1, Panels A and B). Reductions in overdose

mortality involving any drug observed in 2018 were concentrated in eastern states, with little change in age-specific mortality in western states. Over the study period, the age distribution of overdose mortality involving any drug shifted in eastern states, with young people (i.e. aged 15–34 years) experiencing the greatest increases in overdose rates in the period 2014–2018 (Figure 1, Panel B). Subgroup analysis identified increased overdose mortality involving synthetic opioids among young people across the country through the second half of the study period (Figure 1, Panels C and D), with more marked increases in the eastern US. Despite reductions in all drug overdose mortality in 2018, synthetic opioid-involved overdose mortality remained elevated in both eastern and western states.

Among young people, age-adjusted mortality rates for overdoses involving any drug increased 3.0% annually in western states (11.5 to 14.8 per 100,000 persons) and 11.4% annually (13.2 to 29.5 per 100,000 persons) in eastern states during the period 2009–2018 (Table 1). Substantial increases in the number of reported deaths among young Black (4.0 to 14.4 per 100,000 persons) and Hispanic (4.6 to 16.1 per 100,000 persons) people were observed in eastern states over the study period. Young people in large metropolitan areas and their surrounding areas experienced greater increases (11.2 to 27.7 per 100,000 persons) over the study period compared to small/medium and micro/noncore metropolitan areas, respectively. Lower rate ratios in young American Indian/Alaska Native (0.82) and Black (1.04) people (compared to the overall [1.99] rate ratio) highlights a greater burden of mortality among these communities in western states compared to eastern states in 2018.

In subgroup analysis examining deaths among young people involving synthetic opioids, age-adjusted mortality rates increased significantly over the study period: 28.3% annually in western states (0.8 to 4.7 per 100,000 persons) and 52.7% annually (0.9 to 20.4 per 100,000 persons) in eastern states. Low numbers of overdose deaths among young people involving synthetic opioids in 2009 prevented temporal analysis; however, the number of deaths among Black people increased from 12 to 996 individuals over the study period. The greatest change in rate between 2009 and 2018 in eastern states occurred in large central/large fringe metropolitan areas: increasing from 0.6 to 20.9 per 100,000 persons. Rate ratios of 2018 mortality data highlight a greater burden of deaths involving synthetic opioids in eastern states among young women, white populations, and areas outside of large metropolitan areas and their surrounding areas.

In 2009, approximately one-quarter of synthetic opioid-involved deaths were among young people in western (24.3%) and eastern (23.7%) states (Supplementary Table 1). This proportion of deaths attributable to young people peaked in 2015 for eastern states (42%) and in 2018 for western states (45.2%). Similar outcomes in age-specific mortality trends and sociodemographic characteristics of deaths were observed in sensitivity analyses excluding states with potential bias in testing and reporting synthetic opioids (see Supplementary materials).

Discussion

This study characterises the temporal trends in overdose mortality involving any drugs and synthetic opioids between 2009 and 2018 in US states, particularly among young people.

Age-specific mortality rates increased substantially among young people (i.e. 15–34 years) between 2014 and 2018 for eastern states, particularly for synthetic opioids. The reduction in mortality rates in eastern states involving any drug in 2018 was not observed for synthetic opioids, suggesting overdose in this group is largely driven by the “third wave” of the drug overdose epidemic (Ciccarone 2019). Among young people, significant increases in mortality rates were evident for all gender, race, ethnicity and urbanisation subgroups over the study period, most notably in large central and fringe metropolitan areas; in each of these subgroups, mortality increases among young people were comparable to those among older adults (Supplementary Table 4). These findings highlight a concentrated burden of disease among young people in the east of the country, necessitating comprehensive harm reduction interventions for mitigating synthetic opioid toxicity.

Temporal trends demonstrating increased mortality in young people in the eastern US is substantiated by previous literature (Jalal et al., 2018). While prior studies demonstrate increased mortality among young people and those residing in eastern US states separately, few studies have examined the interaction of these factors. Among young people, risk for overdose includes sociodemographic (e.g. gender, race), substance use (e.g. polysubstance use, injection drug use, opioid consumption), psychiatric comorbidities (e.g. depression, suicidality), and psychosocial (e.g. witnessing an overdose, unstable housing) factors (Lyons et al., 2019). In the US, contamination of white-powder heroin and pressed pills with IMF has contributed to increased mortality in the east of the country (Zoorob, 2019). The synthetic opioid overdose epidemic among young adults necessitates targeted interventions to prevent the tragedy of continued overdose deaths in this population.

While overdose deaths among non-Hispanic white people increased over the study period, this study indicates the inaccuracy of characterising the overdose crisis as a public health concern to this group alone (Ruhm, 2019). Mortality rates involving synthetic opioids for non-Hispanic Black populations in 2018 approached those of non-Hispanic white populations in the US (Wilson et al., 2020); however, less is known about the age and geographic sub-epidemics within these populations. This study reveals a less pronounced disparity in mortality rates by geographic location for minority populations, suggesting a broader burden of synthetic opioid overdose across the country. Efforts to prevent a precipitous rise in overdose mortality among these populations will require substantial investment to maintain and expand current harm reduction and public health interventions.

There are limitations related to these findings. First, inconsistencies in postmortem drug overdose data may arise from misreporting or underreporting as states vary in their ability to classify drugs of overdose, and novel analogues of fentanyl are difficult to identify in standard toxicology labs and therefore may be underreported in surveillance data (Slavova et al., 2019). Sensitivity analyses excluding states with potentially poor drug-specific reporting practices demonstrated comparable results (see Supplementary Information). Secondly, misclassification of race and ethnicity—especially among American Indians and Alaskan Native or Hispanic and Latino populations—may lead to underestimates in these groups. Third, while other work characterizes IMF and its analogues as specific drivers of overdose mortality (O'Donnell et al., 2017; Wilson et al., 2020), MCD files only report these deaths as involving “synthetic opioids other than methadone,” a category which includes other

drugs, including tramadol and meperidine. Prior research has shown that increases in synthetic opioid deaths are strongly correlated with law enforcement seizures of drugs containing IMF or related analogs, providing evidence that the majority of deaths in this category can be attributed to fentanyl (Gladden et al., 2016).

Modifications to drug policy to ameliorate excess overdose risk among young people in the US must address existing barriers to prevention and treatment services. For example, access to medications for opioid use disorder is vastly inadequate and adolescents and young adults receiving treatment have lower retention than older adults (National Academies of Sciences, Engineering, and Medicine, 2019), due to multiple factors including stigma and lack of availability (Hadland et al., 2018). Addressing these barriers will require additional education for providers, patients, and the community regarding the effectiveness of these treatments among young people, in addition to simplified prescribing practices (Hadland et al., 2018). High willingness among young people who use drugs to attend supervised consumption facilities, which reduce overdose fatality, (Bouvier et al., 2017) should prompt changes to legislation, policy, and practice in the US, allowing a proportionate response to the burden of the current overdose epidemic. Furthermore, tailoring of harm reduction interventions specifically towards young people would likely impact acceptability and uptake in this population (Marshall et al., 2016).

The current study aimed to characterise temporal trends in overdose mortality among young people in the US in the period 2009–2018. Mortality involving synthetic opioids other than methadone—predominately fentanyl and analogues—increased substantially for young people in the east of the US. Racial/ethnic minority populations are significantly affected by overdose mortality, including among young people. Efforts to reverse trends in overdose mortality involving any drugs and synthetic opioids must consider the unique situations and circumstances in geographic and sociodemographic subpopulations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1:

Age-specific mortality rates by year for deaths involving any drug in western (A) and eastern (B) states, and deaths involving synthetic opioids other than methadone in western (C) and eastern states (D) in the United States, 2009–2018

Table 1:

Number and age-adjusted rate (per 100,000 people) of drug overdose deaths among people aged 15–34 years by drug class and region and by sex, race and ethnicity, and urbanisation level in the United States, 2009 and 2018.

	Western States			Eastern States			Rate Ratio (2018; East: West)
	2009 No. (rate)	2018 No. (rate)	Annual % change in rate, 2009 to 2018 (Confidence Interval)	2009 No. (rate)	2018 No. (rate)	Annual % change in rate, 2009 to 2018 (Confidence Interval)	
All drug							
Overall	4148 (11.5)	5914 (14.8)	3.0 * (1.7, 4.3)	6242 (13.2)	14919 (29.5)	11.4 * (8.2, 14.6)	1.99
Sex							
Male	2922 (15.8)	4259 (20.8)	3.4 * (1.9, 5.0)	4499 (19.0)	10406 (40.7)	12.0 * (8.1, 16.1)	1.96
Female	1226 (6.9)	1655 (8.6)	1.9 * (0.9, 2.9)	1743 (7.4)	4513 (18.0)	12.0 * (8.8, 15.2)	2.09
Race							
White	3755 (13.0)	4983 (16.1)	2.5 * (1.3, 3.8)	5815 (16.4)	13205 (35.9)	11.7 * (8.3, 15.1)	2.23
Black	190 (5.8)	564 (13.8)	9.9v (7.4, 12.5)	356 (4.0)	1495 (14.4)	19.4 * (14.2, 24.8)	1.04
Asian/Pacific Islander	69 (2.3)	178 (4.6)	6.4 * (3.8, 9.0)	49 (2.2)	157 (5.2)	16.0 * (9.8, 22.5)	1.13
American Indian/Alaska Native	134 (14.3)	189 (17.6)	4.0 * (2.1, 6.0)	22 (5.5)	62 (14.5)	13.8 * (7.1, 21.0)	0.82
Ethnicity							
Hispanic or Latino	592 (5.6)	1197 (9.9)	6.9 * (5.2, 8.5)	294 (4.6)	1145 (16.1)	19.0 * (14.1, 24.1)	1.63
Non-Hispanic	3540 (13.8)	4702 (16.9)	2.3 * (1.0, 3.6)	5939 (14.3)	13721 (31.5)	11.6 * (8.1, 15.2)	1.86
Not Stated	16 (N/A)	15 (N/A)	—	†	53 (N/A)	—	—
Urbanisation level							
Large central/ large fringe	2076 (10.2)	3444 (15.1)	4.2 * (2.8, 5.7)	2721 (11.2)	7361 (27.7)	12.7 * (9.6, 15.9)	1.93
Small/medium	1453 (13.0)	1800 (14.9)	1.9 * (0.5, 3.4)	1595 (14.0)	3843 (31.7)	11.4 * (7.8, 15.0)	2.13
Micro/noncore	619 (13.1)	670 (13.8)	1.0 (−0.4, 2.4)	846 (15.6)	1368 (25.4)	7.6 * (4.6, 10.7)	1.91
Synthetic opioid other than Methadone							
Overall	295 (0.8)	1891 (4.7)	28.3 * (16.6, 41.1)	410 (0.9)	10317 (20.4)	52.7 * (35.8, 71.8)	4.34
Sex							
Male	181 (1.0)	1428 (7.0)	33.4 * (21.0, 47.0)	283 (1.2)	7326 (28.7)	52.5 * (34.7, 72.7)	4.10
Female	114 (0.6)	463 (2.4)	25.1 * (14.0, 37.4)	127 (0.5)	2991 (11.9)	51.3 * (36.9, 67.3)	4.96
Race							
White	268 (0.9)	1561 (5.1)	26.7 * (15.9, 38.6)	396 (1.1)	9190 (25.0)	51.6 * (35.1, 70.1)	4.90

	Western States			Eastern States			Rate Ratio (2018; East: West)
	2009 No. (rate)	2018 No. (rate)	Annual % change in rate, 2009 to 2018 (Confidence Interval)	2009 No. (rate)	2018 No. (rate)	Annual % change in rate, 2009 to 2018 (Confidence Interval)	
Black	$\dagger$	227 (5.6)	—	12 ($\dagger$)	996 (9.6)	—	1.71
Asian/Pacific Islander	$\dagger$	44 (1.2)	—	$\dagger$	93 (3.0)	—	2.50
American Indian/Alaska Native	15 ($\dagger$)	59 (5.5)	—	$\dagger$	38 (9.3)	—	1.69
Ethnicity							
Hispanic or Latino	19 ($\dagger$)	374 (3.1)	—	18 ($\dagger$)	814 (11.5)	—	3.71
Non-Hispanic	273 (1.0)	1515 (5.5)	26.3 * (15.0, 38.8)	390 (0.9)	9467 (21.8)	52.1 * (35.5, 70.8)	3.96
Not Stated	$\dagger$	$\dagger$	—	$\dagger$	36 (N/A)	—	—
Urbanisation level							
Large central/large fringe	108 (0.5)	1303 (5.8)	41.2 * (27.8, 55.9)	176 (0.6)	6164 (20.9)	56.6 * (35.6, 80.9) *	3.60
Small/medium	117 (1.0)	442 (3.6)	21.1 * (11.3, 31.7)	133 (1.0)	3151 (21.5)	51.3 * (36.9, 67.2)	5.97
Micro/noncore	70 (1.5)	146 (3.0)	9.9 * (3.6, 16.6)	101 (1.5)	1002 (15.8)	39.3 * (27.8, 51.8)	5.27

* Significant at $p < 0.05$.

$\dagger$ Cells containing <10 cases are not reported, and mortality rates calculated from <20 cases are unreliable and not reported.