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Characteristics of fatal drug overdoses among college age decedents in Tennessee, 2019–2020

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ABSTRACT

Purpose: College age persons experienced unique disruptions to their regular lives during the COVID-19 pandemic, sometimes resulting in negative coping mechanisms. We examined changes in the number of and characteristics of college age fatal drug overdoses before and during the early COVID-19 pandemic.

Methods: We conducted a statewide cross-sectional study to determine the changes in the number and characteristics of college age fatal drug overdose decedents before and during the COVID-19 pandemic using 2019–2020 data from the Tennessee State Unintentional Drug Overdose Reporting System. We defined college age as 18–24 years. Frequencies and rates were generated to compare demographics, circumstances, and toxicology between 2019 and 2020.

Results: From 2019 to 2020, 336 college age persons experienced an unintentional or undetermined fatal drug overdose in Tennessee. Characteristics of college age decedents: mean age 21.7 years, 68.5% males, and 71.4% White. Rates of fatal overdoses among college age persons increased 50.0% overall, 150.1% for female decedents, and 141.7% for Black decedents. Fewer people were treated for substance use disorder or mental health conditions ($p = 0.0243$) in 2020.

Conclusion: This analysis can inform local and regional public health workers to implement focused prevention and intervention efforts to curtail the overdose epidemic among college age persons in Tennessee.

1. Introduction

The COVID-19 pandemic placed an unprecedented burden on the psychological and behavioral health of people in the United States. A possible indicator of this is the rapid increase in the number of fatal drug overdoses the nation witnessed during the pandemic. While fatal drug overdoses were increasing in the years prior to the pandemic, numbers reached record highs in 2020, specifically in March to May of 2020 when many states noted the highest death tolls [1–7]. Trends throughout the nation mirror those going on in Tennessee which saw a 46% increase in the age adjusted rate of fatal drug overdoses from 2019 to 2020 [8]. Increases in fatal drug overdoses during the pandemic have been attributed to several factors including increases in illicit fentanyl, social isolation, social and economic stress, and disruption of treatment for substance use disorder (SUD) [6,7].

College age people faced unique disruptions to their regular lives during the pandemic, some of which included, rapidly moving out of dormitories, adjusting to online learning, and social isolation from lockdown [9,10]. Multiple studies have noted increased levels of anxiety and depression in college age people as well as increases in negative coping mechanisms including use of alcohol and marijuana [9–12]. However, others have noted decreases in use of drugs and alcohol due to being at home with family [13–15]. In any case, unintentional drug overdose mortality among young people has been increasing since before the pandemic [16–17], with reason to believe the increase will continue due to the stress put on this population from the pandemic. We sought to determine characteristics of fatal drug overdoses in college age persons in Tennessee before and during the COVID-19 pandemic.

2. Materials and methods

2.1. Data sources

The Tennessee Department of Health routinely conducts fatal drug overdose surveillance through the State Unintentional Drug Overdose Reporting System (SUDORS). SUDORS captures details associated with fatal overdoses using death certificate, death scene investigation, autopsy, toxicology data, and Prescription Drug Monitoring Program data known

Abbreviations: CDC, Centers for Disease Control and Prevention; CSMD, Controlled Substance Monitoring Database; SUD, Substance Use Disorder; SUDORS, State Unintentional Drug Overdose Reporting System.

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as Controlled Substance Monitoring Program Database (CSMD) in Tennessee. SUDORS is nested within the National Violent Death Reporting System and is funded by the Overdose Data to Action grant from the Centers for Disease Control and Prevention (CDC). Fatal drug overdoses were selected using International Classification of Disease, Tenth Revision cause of death codes X40–44, Y10–14, and T36–50 to identify deaths occurring in Tennessee regardless of state of residence from the Tennessee statistical death file. Text search for cause of death fields looking for overdose terms such as “overdose” or “intoxication”, “toxicity”, etc. and drug terms such as “fentanyl”, “heroin”, etc. was also used to identify cases when codes were not available on the death certificate. All cases were manually reviewed to confirm inclusion. Additionally, cases underwent quality control checks with the CDC.

The State Medical Examiner's office provided access to decedent autopsy reports and toxicology reports. SUDORS cases were linked to their prescription history in the CSMD using a unique person identifier created from name and date of birth. Abstracted data included demographic characteristics, injury and death details, personal circumstances, drug history, death scene investigation, response to drug overdose, prescription fill history for controlled substances, and toxicology data. Cases are abstracted into REDCap by one team member and reviewed by another [18–21]. Prior to submitting final data to SUDORS the data undergo a case validation and error report process.

2.2. Study variables

SUDORS data from January 1, 2019 to December 31, 2020 were obtained from the finalized SAS data file from CDC for Tennessee.

2.2.1. Demographic and circumstance information

Demographic features include age, race/ethnicity, sex, and rural or urban residence. Circumstances include history of SUD, history of treatment for SUD, overdose location, and death location. College age was defined as persons 18–24 years of age. Race and ethnicity and sex were determined using death certificate information. A bystander was identified using autopsy narrative text and defined as someone present during the overdose who had the ability to intervene. Presence of naloxone was determined using toxicology and autopsy narrative text. If buprenorphine and naloxone were noted on toxicology and naloxone administration was not mentioned in the narrative, the naloxone administration variable was not endorsed.

2.2.2. Toxicology and CSMD data

Drugs were identified from toxicology reports or as a cause of death on the death certificate in cases where no toxicology report was available. For this analysis, stimulants were defined using amphetamine and cocaine drug classes from post-mortem toxicology. These classes include prescription amphetamines, illicit amphetamines, illicit methamphetamine, and cocaine and its associated metabolites. When looking at prescription history, we define several timeframes. We define “ever” prescribed as any prescription dating back to 2012 as CSMD prescription data is first available then. Other timeframes include a prescription within 30 days of death, and a prescription within 180 days of death. We also looked at active prescriptions at the time of death defined as having overlapping days' supply with date of death.

2.3. Statistical analysis

Tennessee does not have SUDORS data prior to 2019 for all drug overdose decedents. To determine any trends in drug overdose in college age persons prior to 2019, we used death certificate data for unintentional and undetermined overdoses occurring between 2012 and 2020. Descriptive statistics were calculated for the full sample of college age overdose deaths. Using SUDORS data from 2019 to 2020, chi-square tests were conducted to determine differences in decedent circumstances between 2019 and 2020. Rates and rate differences were calculated per 100,000 population for Tennessee residents for age, sex, and race/ethnicity using population data from CDC WONDER Bridged-Race Population Estimates [22]. All analyses were conducted in SAS version 9.4 (SAS Institute, Cary, NC). *P*-values <0.05 were considered statistically significant. This cross-sectional study was considered exempt by the Tennessee Department of Health's Institutional Review Board.

3. Results

When examining death certificate data from 2012 to 2020, college age persons experienced an overall increase in unintentional and undetermined fatal drug overdose. While the pattern fluctuates over time, the sharpest increase occurred between 2019 and 2020 (Fig. 1).

We identified 336 college age fatal overdoses using SUDORS data from January 1, 2019 to December 31, 2020. In 2019, college age overdoses peaked in November, while in 2020, college age overdoses peaked in May 2020 (Fig. 2).

3.1.1. College age decedents characteristics (Table 1)

Overall, college age decedents had an average age of 21.7(1.73 std). Most were male (68.5%), White (71.4%), and living in an urban area (83.9%). History of SUD and mental health condition was found in 66.7% and 13.4% of decedents respectively. Only 8.0% of decedents were ever treated for SUD or a mental health condition. Most decedents overdosed at a house or apartment (74.1%). Death location was spread out among home, Emergency Room, hospital inpatient, and other location, however the highest proportion died at home (35.7%). Overall, 27.7% of fatal overdoses had a bystander present who had the potential to intervene and 37.2% of decedents were administered naloxone.

3.1.2. Comparison of college age decedents between 2019 and 2020 (Table 1)

Table 1 shows comparisons of college age decedents between 2019 and 2020. Notable differences include a slight decrease in the mean age from 22.1(1.48 SD) to 21.5(1.84 SD) and increases in the proportion of female (37.1% vs. 22.9%) and Black decedents (22.9% vs. 13.7%). Fewer decedents had a history of SUD in 2020 compared to 2019 (64.4% vs. 70.2%). Decedents with a history of treatment for SUD decreased between 2019 and 2020 (5.4% vs. 12.2%). More decedents had a bystander present during the overdose who had the potential to intervene in 2020 (31.7% vs. 21.4%), however, naloxone was not administered more frequently.

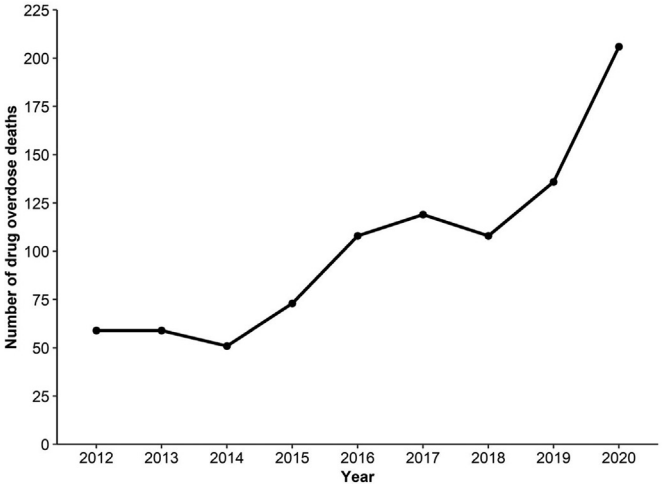

Fig. 1. Number of Unintentional and Undetermined College Age Fatal Drug Overdoses in Tennessee, 2012–2020. Data is from the Tennessee Death Statistical File. Counts of overdose deaths in the Tennessee Death Statistical File are slightly different from State Unintentional Drug Overdose Reporting System counts due to differing case definitions.

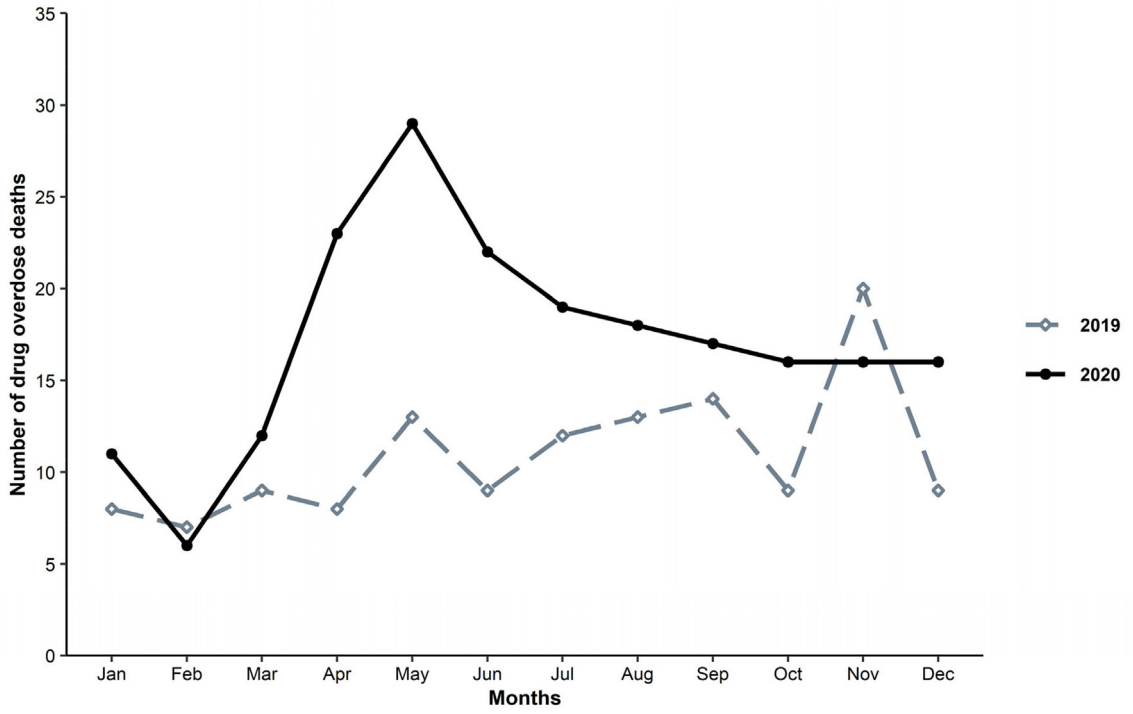

Fig. 2. Monthly Comparison of College Age Fatal Overdose Trends in Tennessee 2019–2020. Data Source: Tennessee State Unintentional Drug Overdose Reporting System.

Table 1
Characteristics of college age decedents[a] TN SUDORS[b] 2019–2020, $n = 336$.

	2019–2020 $n = 336$	2019 $n = 131$	2020 $n = 205$	p-value
	Mean (std)	Mean(std)	Mean (std)	
Age	21.7(1.73)	22.1(1.48)	21.5(1.84)	0.0016
Characteristic	n(%)	n(%)	n(%)	
Sex				
Male	230(68.5)	101(77.1)	129(62.9)	0.0064
Female	106(31.6)	30(22.9)	76(37.1)	0.0064
Race/Ethnicity				
Non-Hispanic White	240(71.4)	101(77.1)	139(67.8)	0.0659
Non-Hispanic Black	65(19.4)	18(13.7)	47(22.9)	0.0376
Non-Hispanic Other	10(2.9)	5(3.8)	5(2.4)	0.4685
Hispanic	21(6.3)	7(5.3)	14(6.8)	0.5837
Rural/Urban				
Urban	282(83.9)	109(83.2)	173(84.4)	0.7732
Rural	54(16.1)	22(16.8)	32(15.6)	0.7732
History of substance use disorder	224(66.7)	92(70.2)	132(64.4)	0.2682
History of mental health condition	45(13.4)	17(13.0)	28(13.7)	0.8580
Ever treated for substance use disorder or mental health condition	27(8.0)	16(12.2)	11(5.4)	0.0243
Overdose Location				
House, apartment	249(74.1)	98(74.8)	151(73.7)	0.0.8143
Hotel/motel	29(8.6)	8(6.1)	21(10.2)	0.1878
Motor vehicle	18(5.4)	8(6.1)	10(4.9)	0.6280
Other	10(2.9)	6(4.6)	4(2.0)	0.1666
Unknown	30(8.9)	11(8.4)	19(9.3)	0.7847
Place of Death				
Home	120(35.7)	47(35.9)	73(35.6)	0.9601
Emergency department	68(20.2)	26(19.9)	42(20.5)	0.8867
Hospital inpatient	38(11.3)	18(13.7)	20(9.8)	0.2607
Dead on arrival	20(6.0)	12(9.2)	8(3.9)	0.0621
Other	86(25.6)	26(19.9)	60(29.3)	0.0536
Undetermined	4(1.2)	2(1.5)	2(0.98)	–
Bystander Present	93(27.7)	28(21.4)	65(31.7)	0.0389
Naloxone Administered	125(37.2)	46(35.1)	79(38.5)	0.5268

[a] 18–24 years of age.
[b] Tennessee State Unintentional Drug Overdose Reporting System.

Table 2
Toxicology by class and individual substances for college age decedents[a] TN SUDORS[b] 2019–2020, $n = 336$.

	2019 $n = 131$	2020 $n = 205$	p-value
	n(%)	n(%)	
Drug Classes[c]			
Illicit opioids	108(82.4)	175(85.4)	0.4737
Prescription opioids	23(17.6)	29(14.2)	0.3992
Stimulants	55(41.9)	85(41.5)	0.9247
Benzodiazepines	44(33.6)	60(29.3)	0.4035
Antidepressants	16(12.2)	27(13.2)	0.7979
Anticonvulsants	4(3.1)	16(7.8)	0.0726
Antipsychotics	5(3.8)	6(2.9)	0.6548
Individual Substances[c]			
Fentanyl	100(76.3)	168(82.0)	0.2115
Heroin	28(21.4)	20(9.8)	0.0030
Methamphetamine	43(32.8)	62(30.2)	0.6187
Cocaine	17(13.0)	20(9.8)	0.3576
Marijuana	57(43.5)	98(47.8)	0.4413
Alcohol	16(12.2)	42(20.5)	0.0503
Alprazolam	21(16.0)	250(13.3)	0.0118

[a] 18–24 years of age.
[b] Tennessee State Unintentional Drug Overdose Reporting System.
[c] Categories not mutually exclusive.

3.1.3. Toxicology comparison between 2019 and 2020 (Table 2)

Table 2 shows comparisons of toxicology between 2019 and 2020. No significant changes occurred when looking at drug classes. When looking at individual substances, involvement of heroin and alprazolam decreased between 2019 and 2020 (21.4% vs. 9.8% and 16.0% vs. 13.3% respectively). Alcohol involvement increased but not significantly. Almost all college age fatal overdoses (95.5%) were polydrug in each year.

3.1.4. Prescription information for college age decedents 2019 and 2020 (Table 3)

Table 3 shows prescription comparisons for college age decedents between 2019 and 2020. Prescription comparisons showed no significant changes in any class or substance between the two years.

Table 3
Comparison of prescription information for TN SUDORS[a] college age[b] decedents between 2019 and 2020, $n = 336$.

Prescription type	2019 ($n = 131$)	2020 ($n = 205$)	
	n (%)	n (%)	p-value
Opioid			
Ever[c]	83 (63.4)	125 (61.0)	0.6609
Within 180 days	11 (8.4)	10 (4.9)	0.1937
With 30 days	2 (1.5)	2 (1.0)	–
Active[d]	–	2 (0.98)	–
Buprenorphine for treatment			
Ever	17 (13.0)	23 (11.2)	0.6275
Within 180 days	10 (7.6)	14 (6.8)	0.7808
Within 30 days	2 (1.5)	4 (2.0)	–
Active	1 (0.76)	2 (0.98)	–
Benzodiazepine			
Ever	19 (14.5)	37 (18.1)	0.3951
Within 180 days	12 (9.2)	18 (8.9)	0.9052
Within 30 days	8 (6.1)	11 (5.4)	0.7743
Active	7 (5.3)	7 (3.41)	0.3882
Stimulant			
Ever	35 (26.7)	46 (22.4)	0.3712
Within 180 days	3 (2.3)	7 (3.4)	–
Within 30 days	–	6 (2.9)	–
Active	–	6 (2.93)	–

[a] Tennessee State Unintentional Drug Overdose Reporting System.
[b] Age 18–24 years.
[c] Ever is defined as lifetime prevalence dating back to 2012.
[d] Active prescription is defined as having overlapping days' supply with date of death.

Table 4
Comparison of mortality rate for college age decedents[a] demographic category between 2019 and 2020 using TN SUDORS[b,d] data, $n = 317$.

Rates[c]	2019	2020	Absolute rate change	% Change	p-value
Overall	20.73	31.07	10.34	50.0%	0.0004
Sex					
Male	31.87	38.76	6.89	21.6%	0.1486
Female	9.27	23.18	13.91	150.1%	<0.0001
Race/Ethnicity					
Non-Hispanic White	22.84	30.49	7.65	33.5%	0.0310
Non-Hispanic Black	13.99	33.82	19.83	141.7%	0.0012
Non-Hispanic Other	31.25	24.95	−6.30	−20.2%	0.7364
Hispanic	16.18	30.87	14.69	90.8%	0.1554

[a] Age 18–24 years.
[b] Tennessee State Unintentional Drug Overdose Reporting System.
[c] Population data from CDC WONDER, rates are calculated per 100,000 population.
[d] Rate calculation is subset to TN Resident Deaths.

3.1.5. Comparison of mortality rate by sex and race between 2019 and 2020 (Table 4)

Table 4 shows mortality rates of college age decedents by demographic category between 2019 and 2020. Rates are bridged age-race adjusted rates for Tennessee residents only. Rate of fatal overdoses increased 50.0% between 2019 and 2020. Female and non-Hispanic Black decedents experienced the greatest increase in fatal overdose rates between 2019 and 2020 (150.1% and 141.7% respectively). Non-Hispanic White decedents experienced an increase of 33.5%.

4. Discussion

Between 2019 and 2020, rates of college age unintentional and undetermined fatal overdoses increased 50% in Tennessee, which is more than the 46% increase in all overdoses in Tennessee in the same time period [8] confirming that this population is experiencing high levels of fatal overdose. The monthly trend of college age fatal overdoses peaked in May of 2020 and slightly tapered off but were still more than fatal overdose counts in 2019 (Fig. 2). This also aligns with a recent modeling study suggesting that excess drug overdose deaths may be due to the pandemic [23–25].

Some may argue that the increase between the two years is attributed to the increase in use of illicit fentanyl which has been a key player in the "fourth wave" of the overdose crisis [26]. Another possibility is the increase in concentration and contamination of fentanyl in the drug supply leading to more deaths [27]. We did see a slight increase in the proportion of college age decedents with a fentanyl involved overdose however, the relationship was not statistically significant (Table 2). This corresponds with research showing increases in fatal fentanyl overdoses between 2019 and 2020 [28]. Fentanyl was involved in over 80% of overdoses in college age persons. This is concerning because of the potency of fentanyl. The same study mentioned above found that one half of fentanyl overdose decedents had no pulse when first responders arrived [28] meaning the administration of naloxone may no longer be effective. This makes connecting people who use drugs to harm reduction strategies even more pertinent.

When looking at toxicology, in addition to fentanyl, marijuana, methamphetamine, and alcohol are the most common substances involved in death. Alcohol involvement increased between 2019 and 2020 which is in contrast to literature and survey data showing decreases in alcohol use among students during the pandemic due to stay at home orders and being near family [29,30]. The only statistically significant changes in toxicology between 2019 and 2020 were decreases in use of heroin and alprazolam. The decrease in heroin in Tennessee is in accordance with other jurisdictions [7,31–33]. Some studies have reported decreasing benzodiazepine use as well [34]. The decrease in alprazolam involvement corresponded with circumstance variables showing less decedents being treated for a mental health condition in 2020 compared to 2019. However, when looking at past prescriptions of benzodiazepines, we saw that similar

proportions of decedents had prescriptions within 30 and 180 days of death. In 2020, a higher percentage of decedents were ever prescribed benzodiazepines compared to 2019 (18.1% vs. 14.5%), but this difference was not significant.

Rate increases of fatal drug overdose among college age decedents occurred among female and Black decedents. Up until 2019, rates of all female fatal drug overdoses remained steadily around 20 per 100,000 residents in Tennessee and jumped to 32 per 100,000 in 2020 [35]. When looking at college age decedents, a sharp increase occurred between 2019 and 2020 for females (9.27 per 100,000 vs. 23.18 per 100,000). While the rate for college age females is not as high as the overall female rate, the sharp increase is alarming [8]. Racial disparities have been well documented in drug overdose literature showing a recent increase in ethnic minorities [36–37]. In Tennessee, rates of overdose among Black persons began increasing in 2018 for all ages [35]. The rate for college age Black decedents was lower than for all ages of Black decedents in 2019 and 2020, however the sharp increase is important to note [8].

In 2020, fatal drug overdose decedents were slightly younger in age, with less reported history of SUD and less history of treatment for SUD. This could suggest that some of the increase in these college age overdoses is people using substances for the first time and having a fatal overdose in part due to the increase in illicit fentanyl in the drug market. This could be due to the increased fentanyl concentrations or contamination described above [27]. Another possibility is the disruption to treatment options for patients during the pandemic [38]. In any case, this study pulled data from multiple sources to show the dramatic increase in fatal drug overdoses that college age decedents experienced during the beginning of the COVID-19 pandemic.

Future efforts should focus on tailoring prevention initiatives to college age persons specifically those who are ethnic minorities and ensuring treatment for SUD and mental health conditions are accessible for all and culturally acceptable. We found that naloxone was administered in 37% of college age decedents. Naloxone training and distribution are essential to this population given the large amount of fentanyl present in toxicology. High school and college campuses should focus on education campaigns that include messaging such as only taking prescriptions that belong to you, not using substances alone, and messaging about the potency of fentanyl and the risk of substances being laced with it, including pills from friends. These education campaigns should also be conducted focusing on young adults not enrolled in college. One possible avenue of conducting these campaigns is via social media. Additionally, promotion of mental health care should occur which could help to link people to treatment specifically medications for opioid use disorder. Naloxone training should be conducted on school campuses and naloxone should be available throughout campuses such as automated external defibrillators. These approaches directly align with the 2022 White House's National Drug Control Strategy which directs federal agencies to expand prevention efforts to school aged children and young adults while increasing the scientific understanding of the recovery process [39].

Another harm reduction strategy adopted in Canada focuses on creating a safe supply of drugs for people to use [40–41]. This involves providing substances such as hydromorphone or diacetylmorphine to people, so they do not need to buy illicit substances. While participant experiences have varied with this approach, successes were seen such as increases in quality-adjusted life-years, and better overall wellness [40–42]. With this approach, it is important to understand substance preference by demographic group [40]. Other approaches include utilizing safe consumption sites [43] and fentanyl test strips which have shown positive uptake in young adults [44–45].

5. Limitations

Our study had several limitations. While we defined college age persons as 18–24 years, the usual years of schooling, we were unable to determine whether the decedents were currently enrolled. Tennessee is organized as a decentralized state with five regional forensic centers with the state agency serving as an advisor. Autopsies used in SUDORS data collection are limited to those sent from the five centers to the state agency. We received autopsy reports for 90% of decedents included in this analysis and feel that missing data is minimal. This study is purely descriptive and is limited to medical history listed in the autopsy report which can be from medical records, autopsy results, and sometimes family and friends as part of scene evidence. When looking at medications for opioid use disorder, the CSMD does not collect information on methadone which may limit the number of people in treatment that this study captures. We did not have information available to determine if any of the substances were laced with fentanyl or if fentanyl was being co-used with other substances. Another limitation is SUDORS lack of data prior to 2019. It will be important to monitor this population in 2021 to examine trends. Finally, another limitation of this analysis is the lack in generalizability to the United States population as this data is only for the state of Tennessee. It is important that states continue to publish reports on their SUDORS data to help build a more complete perspective on the widespread issue of fatal drug overdoses.

6. Conclusion

Rates of fatal drug overdoses among college age persons increased in Tennessee between 2019 and 2020. This analysis can inform local and regional public health workers to implement focused prevention and intervention efforts to curtail the overdose epidemic among college age persons in Tennessee. Specific education and training initiatives should be tailored for this demographic group and carried out early in high schools and on college campuses to spread awareness of the dangers of fentanyl as well as what to do if someone encounters an overdose.

Author contributions

Dr. Mukhopadhyay and Ms. Korona-Bailey designed the study. Ms. Korona-Bailey conducted primary analyses and wrote the first draft of the manuscript. Both authors contributed to and approved the final manuscript for publication and have no conflicts of interest to disclose.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] Heuveline P. The COVID-19 pandemic adds another 200,000 deaths (50%) to the annual toll of excess mortality in the United States. PNAS. 2021;118(36):e2107590118.
[2] Wakeman SE, Green TC, Rick J. An overdose surge will compound the COVID-19 pandemic if urgent action is not taken. Nat Med. 2020;26:819–20. https://doi.org/10.1038/s41591-020-0898-0.
[3] Haley DF, Saltz R. The opioid epidemic during the COVID-19 pandemic. JAMA. 2020;324(16):1615–7. https://doi.org/10.1001/jama.2020.18543.
[4] Stephenson J. Drug overdose deaths head toward record number in 2020, CDC warns. JAMA Health Forum. 2020;1(10):e201318. https://doi.org/10.1001/jamahealthforum.2020.1318.
[5] Friedman J, Akre S. COVID-19 and the drug overdose crisis: uncovering the deadliest months in the United States, January-July 2020. AJPH. 2021;111(7):1284–91.
[6] Kuehn B. Accelerated overdose deaths linked with COVID-10. News and Analysis JAMA. 2021;325(6):523.

[7] Hedegaard H, Minino AM, Spencer MR, Warner M Drug Overdose Deaths in the United States, 1999-2020. National Center for Health Statistics. https://www.cdc.gov/nchs/products/databriefs/db428.htm. Accessed April 28, 2022.
[8] 2020 Tennessee Drug Overdose Deaths. Office of Informatics and Analytics. Tennessee Department of Health, Nashville, TN. https://www.tn.gov/content/dam/tn/health/documents/pdo/2020_Tennessee_Drug_Overdose_Deaths.pdf; March, 2021. Accessed April 28, 2022.
[9] Copeland WE, McGinnis E, Bai Y, et al. Impact of COVID-19 pandemic on college students' mental health and wellness. J Am Acad Child Adolesc Psychiatry. 2021;60(1):134–41.
[10] Avena NM, Simkus J, Lweandowski A, Gold MS, Potenza MN. Substance use disorders and behavioral addictions during the COVID-19 pandemic and COVID-19 related restrictions. Front Psych. 2021;12:653674.
[11] Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on college students' mental health in the United States: interview survey study. JMIR. 2020;22(9):e21279. https://doi.org/10.2196/21279.
[12] Horigian VE, Schmidt RD, Feaster DJ. Loneliness, mental health, and substance use among US young adults during COVID-19. J Psychoactive Drugs. 2021;53(1):1–9. https://doi.org/10.1080/02791072.2020.1836435.
[13] Papp LM, Kouros CD. Effect of COVID-10 disruptions on young adults' affect and substance use in daily life. Psychol Addict Behav. 2021;35(4):391–401. https://doi.org/10.1037/adb0000748.
[14] Merrill JE, Stevens AK, Jackson KM, White HR. Changes in Cannabis consumption among college students during COVID-19. J Stud Alcohol Drugs. 2022;83(1):55–62. https://doi.org/10.15288/jsad.2022.83.55.
[15] White HR, Stevens AK, Hayes K, Jackson KM. Changes in alcohol consumption among college students due to COVID-19: effects of campus closure and residential change. J Stud Alcohol Drugs. 2020;81(6):725–30. https://doi.org/10.15288/jsad.2020.81.725.
[16] Hall OT, Trimble C, Garcia S, Entrup P, Deaner M, Teater J. Unintentional drug overdose mortality in years of life lost among adolescents and young people in the US from 2015 to 2019. JAMA Pediatr. 2022;176(4):415–7. https://doi.org/10.1001/jamapediatrics.2021.6032.
[17] Hingson R, Zha W, Smyth D. Magnitude and trends in heavy episodic drinking, alcohol-impaired driving, and alcohol-related mortality and overdose hospitalizations among emerging adults of college ages 18-24 in the United States, 1998-2014. J Stud Alcohol Drugs. 2017;78(4):540–8. https://doi.org/10.15288/jsad.2017.78.540.
[18] Korona-Bailey J, Nechuta S, Golladay M, Moses J, Bastasch O, Krishnaswami S. Characteristics of fatal opioid overdoses with stimulant involvement in Tennessee: a descriptive study using 2018 State Unintentional Drug Overdose Reporting System Data. Ann Epidemiol. 2021;58:149–55. https://doi.org/10.1016/j.annepidem.2021.03.004.
[19] Roberts A, Saint SR. Presented at Overdose Data to Action Recipient Meeting; 22-23 June 2021. Virtual.
[20] Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377–81. https://doi.org/10.1016/j.jbi.2008.08.010.
[21] Harris PA, Taylor R, Minor BL, et al. REDCap Consortium, The REDCap consortium: Building an international community of software partners. J Biomed Inform. 2019;95(1):103208.
[22] United States Department of Health and Human Services (US DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS). Bridged-Race Population Estimates, United States July 1st resident population by state, county, age, sex, bridged-race, and Hispanic origin, on CDC WONDER On-line Database. https://wonder.cdc.gov/wonder. Accessed April 28,2022.
[23] Currie JM, Schnell MK, Schwandt H, Zhang J. Trends in drug overdose mortality in Ohio during the first 7 months of the COVID-19 pandemic. JAMA Netw Open. 2021;4(4):e217112. https://doi.org/10.1001/jamanetworkopen.2021.7112.
[24] Macmadu A, Batthala S, Correia Gabel AM, et al. Comparison of characteristics of deaths from drug overdose before vs during the COVID-19 pandemic in Rhode Island. JAMA Netw Open. 2021;4(9):e2125538. https://doi.org/10.1001/jamanetworkopen.2021.25538.
[25] Cartus AR, Li Y, Macmadu A, et al. Forecasted and observed drug overdose deaths in the US during the COVID-19 pandemic in 2020. JAMA Netw Open. 2022;5(3):e223418. https://doi.org/10.1001/jamanetworkopen.2022.3418.
[26] Friedman J, Beletsky L. Surging racial disparities in the U.S. overdose crisis. Am J Psychiatry. 2022;179(2):166–9. https://doi.org/10.1176/appi.ajp.2021.21040381.
[27] Palis H, Bélair MA, Hu K, Tu A, Buxton J, Slaunwhite A. Overdose deaths and the COVID-19 pandemic in British Columbia, Canada. Drug Alcohol Rev. 2022;41(4):912–7. https://doi.org/10.1111/dar.13424.
[28] O'Donnell J, Tanz LJ, Gladden RM, Davis NL, Bitting J. Trends in and characteristics of drug overdose deaths involving illicitly manufactured fentanyls—United States, 2019–2020. Morb Mortal Wkly Rep. 2021 Dec 17;70(50):1740. https://doi.org/10.15585/mmwr.mm7050e3.
[29] Graupensperger S, Jaffe AE, Fleming CNB, Kilmer JR, Lee CM, Larimer ME. Changes in college student alcohol use During the COVID-19 pandemic: are perceived drinking norms still relevant? Emerg Adulthood. 2021;9(5):531–40. https://doi.org/10.1177/2167696820986742.
[30] Jaffe AE, Kumar SA, Ramirez JJ, DiLillo D. Is the COVID-19 pandemic a high-risk period for college student alcohol use? A comparison of three spring semesters. Alcoholism. 2021;45(4):854–63. https://doi.org/10.1111/acer.14572.
[31] Wilson N, Kariisa M, Seth P, Smith 4th H, Davis NL. Drug and opioid-involved overdose deaths - United States, 2017–2018. MMWR Morb Mortal Wkly Rep. 2020;69(11):290–7. Published 2020 Mar 20. 10.15585/mmwr.mm6911a4.
[32] Mattson CL, Tanz LJ, Quinn K, Kariisa M, Patel P, Davis NL. Trends and geographic patterns in drug and synthetic opioid overdose deaths — United States, 2013–2019. MMWR Morb Mortal Wkly Rep. 2021;70:202–7. https://doi.org/10.15585/mmwr.mm7006a4.
[33] Foglia R, Kline A, Cooperman NA. New and emerging opioid overdose risk factors. Curr Addict Rep. 2021;8:319–29. https://doi.org/10.1007/s40429-021-00368-6.
[34] Bollinger K, Weimer B, Heller D, Bynum N, Grabenauer M, Pressley D, Smiley-McDonald H. Benzodiazepines reported in NFLIS-Drug, 2015 to 2018. *Forens Sci Int Synergy*. 2021;3(100138).
[35] Tennessee's Annual Overdose Report. Report on Epidemiologic Data and Projects to Address the Overdose Epidemic. Office of Informatics and Analytics. Tennessee Department of Health, Nashville, TN. March, 2021; 2021.
[36] Kiang MV, Acosta RJ, Chen Y, Matthay EC, Tsai AC, Basu S, et al. Sociodemographic and geographic disparities in excess fatal drug overdoses during the COVID-19 pandemic in California: a population-based study. Lancent Regional Health – Americas. 2022;11:100237.
[37] 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). https://doi.org/10.1126/science.aau1184. eaau1184.
[38] Alexander GC, Stoller KB, Haffajee RL, Saloner B. An epidemic in the midst of a pandemic: opioid use disorder and COVID-19. Ann Intern Med. 2020;173(1):57–8. https://doi.org/10.7326/M20-1141.
[39] Fact Sheet: White House Releases 2022 National Drug Control Strategy that Outlines Comprehensive Path Forward to Address Addiction and the Overdose Epidemic. The White House. Whitehouse.gov; 2022. [Accessed 30 April 2022]. available at. https://www.whitehouse.gov/briefing-room/statements-releases/2022/04/21/fact-sheet-white-house-releases-2022-national-drug-control-strategy-that-outlines-comprehensive-path-forward-to-address-addiction-and-the-overdose-epidemic/.
[40] Ferguson M, Parmar A, Papamihali K, Weng A, Lock K, Buxton JA. Investigating opioid preference to inform safe supply services: a cross sectional study. Int J Drug Policy. 2022;101:103574. https://doi.org/10.1016/j.drugpo.2021.103574.
[41] McNeil R, Fleming T, Mayer S, et al. Implementation of safe supply alternatives during intersecting COVID-19 and overdose health emergencies in British Columbia, Canada, 2021. Am J Public Health. 2022;112(S2):S151–8. https://doi.org/10.2105/AJPH.2021.306692.
[42] Ivsins A, Boyd J, Beletsky L, McNeil R. Tackling the overdose crisis: the role of safe supply. Int J Drug Policy. 2020;80:102769. https://doi.org/10.1016/j.drugpo.2020.102769.
[43] Suen LW, Davidson PJ, Browne EN, Lambdin BH, Wenger LD, Kral AH. Effect of an unsanctioned safe consumption site in the United States on syringe sharing, rushed injections, and isolated injection drug use: a longitudinal cohort analysis. J Acquir Immune Defic Syndr. 2022;89(2):172–7. https://doi.org/10.1097/QAI.0000000000002849.
[44] Weicker NP, Owczarzak J, Urquhart G, et al. Agency in the fentanyl era: exploring the utility of fentanyl test strips in an opaque drug market. Int J Drug Policy. 2020;84:102900. https://doi.org/10.1016/j.drugpo.2020.102900.
[45] Krieger MS, Goedel WC, Buxton JA, et al. Use of rapid fentanyl test strips among young adults who use drugs. Int J Drug Policy. 2018;61:52–8. https://doi.org/10.1016/j.drugpo.2018.09.009.