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Pregnancy-associated homicide, suicide and unintentional opioid-involved overdose deaths, North Carolina 2018–2019

Anna E. Austin[a,b], **Rebecca B. Naumann**[b,c], **Bethany L. DiPrete**[c], **Shana Geary**[d], **Scott Proescholdbell**[d], **Kathleen Jones-Vessey**[e]

[a]Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

[b]Injury Prevention Research Center, University of North Carolina at Chapel Hill

[c]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill

[d]Injury and Violence Prevention Branch, Division of Public Health, North Carolina Department of Health and Human Services

[e]Title V Office, Division of Public Health, North Carolina Department of Health and Human Services

Abstract

Objective: Rates of death due to homicide, suicide, and overdose during pregnancy and the first year postpartum have increased substantially in the United States in recent years. The aims of this study were to use 2018–2019 data on deaths identified for review by the North Carolina Maternal Mortality Review Committee (NC-MMRC) and data from the North Carolina Violent Death Reporting System (NC-VDRS) and Statewide Unintentional Drug Overdose Reporting System (NC-SUDORS) to examine homicide, suicide, and unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum.

Methods: We linked data from the 2018–2019 NC-MMRC to suicide and homicide deaths among women ages 10–50 years from the 2018–2019 NC-VDRS and to unintentional opioid-involved overdose deaths among women ages 10–50 years from the 2018–2019 NC-SUDORS. We conducted descriptive analyses to examine the prevalence of demographic characteristics and circumstances surrounding each cause of death.

Results: From 2018–2019 in North Carolina, there were 23 homicide, 9 suicide, and 36 unintentional opioid-involved overdose deaths (9.7, 3.8, and 15.1 per 100,000 live births, respectively) during pregnancy and the first year postpartum. Most homicide deaths (87.0%) were by firearm, and more than half (52.5%) were related to IPV. More than two-thirds of women who died by suicide had a current mental health problem (77.8%). Less than one-fourth (22.2%) who died by unintentional opioid-involved overdose had a known history of substance use disorder treatment.

Corresponding author: Anna Austin, University of North Carolina at Chapel Hill, 421 Pittsboro St, CB# 7440, Chapel Hill, NC 27599-7440, anna.austin@unc.edu.

Conclusion: Our approach to quantifying and describing these causes of pregnancy-associated death can serve as a framework for other states to inform data-driven prevention.

Deaths during pregnancy and postpartum are a clear and pressing public health issue in the United States. Any death occurring during pregnancy or the first year postpartum, regardless of the cause, is considered a pregnancy-associated death.[1] Importantly, in the past, research, surveillance, and prevention efforts have primarily focused only on pregnancy-related deaths, or deaths during pregnancy and the first year postpartum due to a cause directly related to or aggravated by the pregnancy or the management of the pregnancy, such as hemorrhage, cardiovascular conditions, and infections.[2] Recent research indicates that homicide, suicide, and overdose account for at least 1 in 5 deaths during pregnancy and the first year postpartum,[3] and rates of death due to these causes have increased dramatically over the past decade.[3–7] However, homicide, suicide, and overdose deaths have traditionally not been classified as pregnancy-related, and thus were not previously included in maternal mortality estimates or considered a primary focus of prevention efforts. Given their substantial and growing role in deaths during pregnancy and the first year postpartum, recent surveillance data classifying suicide and overdose as pregnancy-related deaths[8] underscoring the need to accurately quantify these causes of death and understand contributing factors.

Existing research quantifying homicide, suicide, and overdose deaths during pregnancy and the first year postpartum has largely relied on the pregnancy checkbox on the death certificate.[3,5,7] The medical certifier, typically a physician, medical examiner, or corner, is legally responsible for the completeness and accuracy of information included in the medical section of the death certificate, including the pregnancy checkbox, and is expected to verify the pregnancy status of all female decedents of reproductive age.[9] Prior research indicates that the pregnancy checkbox has low sensitivity and specificity,[10] and an investigation using 2001–2008 data from Maryland found that the pregnancy checkbox did not capture more than half of deaths due to non-obstetric causes, including homicide, suicide, and overdose deaths.[11] State and local Maternal Mortality Review Committees (MMRCs) are multidisciplinary teams that review information from multiple linked data sources (e.g., vital statistics, hospital discharge records) to identify all pregnancy-associated deaths (i.e, all deaths during pregnancy and the first year postpartum), [12] classify these deaths as pregnancy-associated, but not pregnancy-related or pregnancy-related, and determine whether pregnancy-related deaths were preventable.[13] Additional statewide surveillance systems, including Violent Death Reporting Systems (VDRS)[14] and Statewide Unintentional Drug Overdose Reporting Systems (SUDORS),[15] collect comprehensive, standardized information on homicide, suicide, and overdose deaths and offer additional timely data to characterize pregnancy-associated deaths.[16]

The aims of this study were to use linked 2018–2019 cases identified for review by the North Carolina (NC) MMRC with VDRS and SUDORS cases to (1) quantify homicide, suicide, and unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum and (2) examine characteristics of and circumstances surrounding these deaths. We used 2018–2019 data as these are the most recent years for which all three data sources are complete. We focused on unintentional opioid-involved overdose deaths

rather than all overdose deaths because the 2018 NC-SUDORS only collected data for unintentional opioid-involved overdose deaths, and opioids are the primary substance contributing to overdose deaths during pregnancy and postpartum.[17]

Methods

Data sources

We first identified all homicide, suicide, and unintentional opioid-involved overdose deaths among women ages 10–50 years, documented in the 2018–2019 NC-VDRS and NC-SUDORS data. NC-VDRS combines data from death certificates, medical examiner reports, and law enforcement reports to provide comprehensive information on deaths due to violence, including homicide and suicide.[18] Similarly, NC-SUDORS combines data from death certificates, medical examiner reports, and postmortem toxicology testing to provide comprehensive information on unintentional and undetermined intent overdose deaths. In both surveillance systems, trained data abstractors manually and electronically extract data from these records using standardized data fields and definitions.[19] Pregnancy or postpartum status is coded in both systems based on information from the pregnancy checkbox on death certificate and in the medical examiner report.

We then linked these deaths to 2018–2019 deaths identified for review by the NC-MMRC. We linked these data using date of death and the last four digits of the death certificate number. North Carolina has used enhanced case identification methodologies, including linkage of multiple public health data sources, to identify pregnancy-associated deaths since 2001 and participated in development of standardized methods for case identification that are currently used by MMRCs throughout the U.S.[12] NC-MMRC data include information on deaths among women ages 10–50 years that occurred during pregnancy or the first year postpartum, regardless of pregnancy outcome. Pregnancy-associated deaths are identified using multiple methods, including linkage of vital statistics data (death, birth, and fetal death certificates), emergency department visit data, and inpatient hospital discharge data. For deaths identified as pregnancy-associated based on the pregnancy checkbox on the death certificate, but that cannot be confirmed as pregnancy-associated through these data linkages or identification of pregnancy-related terms in literal text on the death on the death certificate, further investigation is conducted using multiple sources such as medical examiner and autopsy reports, obituaries, social media, and news reports (see Supplemental Table 1 for the number of deaths identified by the pregnancy checkbox on the death certificate alone as compared to the linked NC-MMRC, NC-VDRS, and NC-SUDORS data). Remaining unconfirmed cases are further investigated by the NC-MMRC case abstraction team using additional sources such as medical charts and law enforcement reports. Of note, the MMRC data we used were for deaths identified for review by the NC-MMRC. While these deaths have been confirmed to be pregnancy-associated, final NC-MMRC determinations for 2018–2019, including whether deaths were considered by the NC-MMRC to be pregnancy-related and preventable, were not yet available as of fall 2023. Thus, NC-VDRS and NC-SUDORS potentially offer more timely data for examining characteristics of and circumstances surrounding pregnancy-associated violent and overdose deaths.

Measures

Demographic characteristics included age, race and ethnicity, and education level as recorded on the death certificate and the timing of death relative to pregnancy (pregnancy, early postpartum (1–42 days postpartum) and late postpartum (≥43 days postpartum)) as recorded in the NC-MMRC data. The method (e.g., firearm, poisoning) of homicide and suicide was recorded in NC-VDRS based on ICD-10 codes from death certificates and information in the medical examiner and law enforcement reports. For unintentional opioid-involved overdose deaths, we searched the literal text from three death certificate fields to identify specific drugs contributing to the overdose using a previously developed tool and a list of terms that included generic drug names, brand names, common usage/street names, misspellings, abbreviations, and metabolites, with each term mapped to a specific drug (Supplemental Table 2).[20]

Circumstances surrounding homicide and suicide deaths in NC-VDRS and unintentional opioid-involved overdose deaths in NC-SUDORS were based on information in the medical examiner and law enforcement reports (Supplemental Table 3).[21] Homicide circumstances included whether the death was related to intimate partner violence (IPV), another type of argument or interpersonal conflict, drug trade or use, another serious crime, a physical fight, and a drive-by shooting. Suicide circumstances included history of mental health treatment, current mental health treatment, current mental health problems, problems with a current or former intimate partner, history of suicide attempts, disclosure of thoughts or plans for suicide, problems with drugs, and depressed mood at the time of death. Circumstances for unintentional opioid-related overdose deaths included whether naloxone was administered, a bystander was present, history of prescription opioid misuse or illicit opioid use, and history of substance use disorder treatment.

Patient and public involvement

There was no patient or public involvement for this study.

Statistical analysis

We first examined the number and rate per 100,000 live births of pregnancy-associated homicide, suicide, and unintentional opioid-involved overdose deaths as identified through the linked NC-MMRC, NC-VDRS, and NC-SUDORS data. We then conducted descriptive analyses to examine the prevalence of demographic and other characteristics and circumstances surrounding homicide, suicide, and unintentional opioid-involved overdose deaths. We conducted analyses in SAS 9.4. This study was reviewed and considered exempt by the University of North Carolina at Chapel Hill IRB.

Results

Performance of linked data sources

From 2018–2019, 23 homicide, 9 suicide, and 36 unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum were identified through the linked NC-MMRC, NC-VDRS, and NC-SUDORS data (Supplemental Table 4). In total there were 9.7 homicide deaths, 3.8 suicide deaths, and 15.1 unintentional opioid-related overdose

deaths per 100,000 live births. Of note, the NC-MMRC data identified 6 homicide and 2 suicide deaths that were not recorded as pregnancy-associated in NC-VDRS and 19 unintentional opioid-involved overdose deaths that were not recorded as pregnancy-associated in NC-SUDORS. NC-VDRS identified 1 homicide and 1 suicide death that were not included in the NC-MMRC data.

Characteristics of decedents

More than half of homicide (60.9%) and suicide (55.6%) deaths were among women ages 15–24 years (Table 1). One-third of unintentional opioid-involved overdose deaths (33.3%) were among women ages 30–34 years. Most homicide deaths were among Black non-Hispanic women (73.6%), and most suicide (66.7%) and unintentional opioid-involved overdose (75.0%) deaths were among White non-Hispanic women. In more than two-thirds of homicide (73.9%), suicide (66.7%), and unintentional opioid-involved overdose (69.4%) deaths, the woman had a high school education or less. One-third of homicide (30.4%) and suicide (33.3%) deaths occurred during pregnancy, and more than half (60.9% and 55.6%, respectively) occurred during the late postpartum period. Most unintentional opioid-involved overdose deaths (83.3%) occurred during the late postpartum period.

Circumstances of homicide, suicide, or unintentional opioid-involved overdose deaths

Most homicide deaths (87.0%) were by firearm (Table 1). More than half of suicide deaths were by hanging, strangulation, or suffocation (55.6%) and nearly one-fourth were by firearm (22.2%). The most common drugs contributing to unintentional opioid-involved overdose deaths were fentanyl (80.6%), heroin (41.7%), cocaine (38.9%), and alprazolam (19.4%). Three-fourths involved multiple drugs, with common combinations including fentanyl and heroin, fentanyl and cocaine, heroin and cocaine, and fentanyl and alprazolam.

More than half of homicide deaths (52.5%) were related to IPV (Figure 1). An additional 39.1% were related to a non-IPV argument or conflict, and 30.4% were precipitated by another serious crime. More than two-thirds of women who died by suicide had a history of mental health treatment (77.8%) and a current mental health problem (77.8%; Figure 2). More than half had a problem with a current or former intimate partner (55.6%) and were in current treatment for a mental health problem (55.6%) at the time of death.

Naloxone was administered in more than half of unintentional opioid-involved overdose deaths (52.8%), and a bystander was present for one-third of deaths (33.3%; Figure 3). Less than one-fourth (22.2%) had a known history of substance use disorder (SUD) treatment, and only 16.7% had no known history of prescription opioid misuse or illicit opioid use.

Discussion

From 2018–2019 in North Carolina, there were 9.7 homicide deaths, 3.8 suicide deaths, and 15.1 unintentional opioid-related overdose deaths per 100,000 live births during pregnancy and the first year postpartum. We found that the 2018–2019 MMRC data captured nearly all homicide, suicide, and unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum and captured more of these deaths than the NC-VDRS or NC-SUODRS data alone. Importantly, while information was available for deaths identified

for review by the NC-MMRC, and these deaths have been confirmed to be pregnancy-associated, final NC-MMRC determinations are typically not available for several years. Thus, NC-VDRS and NC-SUDORS offer more timely data for examining characteristics of and circumstances surrounding pregnancy-associated violent and overdose deaths. This highlights the importance of sharing information across multiple surveillance systems (e.g., MMRCs sharing case identification information with VDRS and SUDORS data abstraction teams) to ensure complete ascertainment, improve the efficiency and accuracy of information, and promote timely dissemination of information critical to prevention efforts.

The demographic composition of pregnancy-associated homicide, suicide, and unintentional opioid-involved overdose deaths differed in notable ways from the demographic composition of all live births in North Carolina in 2018–2019. While more than half of homicide and suicide deaths were among women ages 15–24 years, only one-fourth of all live births were among this age group.22 In addition, three-fourths of homicide deaths were among Black non-Hispanic women, whereas one-fourth of all live births were among Black non-Hispanic women.[22] Last, more than two-thirds of homicide, suicide, and unintentional opioid-involved overdose deaths were among women with a high school education or less compared to one-third of all live births.[22] These results highlight populations with a disproportionate burden of pregnancy-associated homicide, suicide, and overdose death. Focused prevention efforts and resource allocation are warranted to reduce these existing disparities.

More than half of homicide deaths during pregnancy and the first year postpartum were related to IPV and most were by firearm, consistent with existing research.[23,24] To date, efforts to address IPV-related homicide deaths have primarily focused on screening for IPV at prenatal and postpartum healthcare visits.[25] While IPV screening is critical to identifying IPV and facilitating connections to supportive resources, the prevalence of screening is low, particularly during the postpartum period,[25] and appropriate follow-up resources may not be available and accessible in all communities. Moreover, access to prenatal and postpartum care is limited for marginalized populations at higher risk for IPV and IPV-related homicide,[23,26] including Black, Hispanic, and American Indian/Alaska Native people and those with lower incomes.[25] As such, broad, population-level strategies may be needed for more widespread reach and impact. Existing evidence indicates that state policies that place restrictions on firearm access (i.e., more stringent background checks to purchase firearms, additional regulations for firearm dealers)[27] and that prohibit those with IPV restraining orders from possessing firearms[28] are associated with lower rates of IPV-related homicide. This indicates that in addition to IPV screening, firearm access policies may be an important component of efforts to prevent IPV-related homicide.

Circumstances related to mental health and conflict with an intimate partner were common among suicide deaths during pregnancy and the first year postpartum. Rates of depression, suicidal ideation, and self-harm during pregnancy and postpartum have increased in recent years,[29] and lack of access to mental health treatment is a key risk factor for pregnancy-associated suicide death.[30] Similar to homicide deaths, efforts to address pregnancy-associated suicide deaths have primarily focused on screening for depression at prenatal and postpartum healthcare visits.[31] However, like IPV screening, limited

availability and accessibility of treatment and resources following screening, particularly among marginalized populations,[32] is a challenge. Policy strategies with the potential for more widespread impact in improving access to mental health treatment and preventing suicide deaths during pregnancy and postpartum include extending postpartum Medicaid coverage, expanding telehealth delivery of mental health services, and implementing social and economic policies that support families, such as paid family leave.[32]

Of the three causes of pregnancy-associated death examined, the rate of unintentional opioid-involved overdose deaths was highest, at 15.1 deaths per 100,000 live births. To reduce rates of opioid overdose deaths among pregnant and postpartum people,[6] expanded access to medication for opioid use disorder (MOUD) and harm reduction services are urgently needed. MOUD is evidence-based treatment for opioid use disorder (OUD) that substantially reduces the risk of fatal and non-fatal opioid overdose, including among pregnant and postpartum people.[33] However, receipt and duration of MOUD is low during pregnancy and postpartum.[34] In our data, though more than 80% of women who died of an unintentional opioid-involved overdose had a known history of prescription opioid misuse or illicit opioid use, less than 1 in 4 had a known history of substance use disorder (SUD) treatment. Many pregnant and postpartum people with SUD delay or avoid healthcare visits and SUD treatment due to stigma and fears of legal consequences, including loss of infant custody.[35] Prior research shows that punitive state prenatal substance use policies (i.e., policies that consider substance use during pregnancy to be child abuse and that require mandated reporting of substance use during pregnancy to child protective services) are associated with delays and reductions in prenatal and postpartum care[36] and lower rates of SUD treatment, including MOUD, among pregnant people.[37] Supportive, treatment-oriented policies, including those that create treatment programs specifically for pregnant and postpartum people,[38] and more widespread implementation of trauma-informed care[39] may help reduce stigma and facilitate engagement in care and treatment for this population.

With respect to harm reduction services, naloxone is a medication that can reverse an opioid overdose and prevent death. In our data, naloxone was administered in more than half of unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum. Notably, among these deaths, more than half of administrations were by a first responder or hospital staff, highlighting the importance of increasing access to naloxone among community and family members to ensure administration is early enough to reverse the overdose. Approaches to expanding naloxone access, including for pregnant and postpartum people, include reclassifying naloxone as an over-the-counter drug, distributing naloxone in easy-to-access public places, passing additional Good Samaritan laws, and implementing free mailed naloxone programs.[40]

While prior studies have examined pregnancy-associated homicide, suicide, and overdose deaths in the U.S. and offered subsequent recommendations for interventions focused on substance use, mental health, and IPV, [41–43] our study adds to this literature in notable ways. First, we linked data from three statewide surveillance systems to ensure complete ascertainment of all homicide, suicide, and unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum and to obtain comprehensive information

on the characteristics of and circumstances surrounding these deaths. Second, based on our results, we offer clear recommendations for policies that can help to address key risk factors for pregnancy-associated homicide, suicide, and overdose deaths at the population-level.

Limitations

Results should be interpreted in the context of limitations. First, data from NC-VDRS and NC-SUDORS regarding circumstances surrounding homicide, suicide, and overdose deaths are limited to what is abstracted from the medical examiner and law enforcement reports. Information in the law enforcement reports largely depends on the completeness of information provided by family and friends. Thus, some circumstances may have been under-counted in these data sources. Second, there is potential for misclassification of the intent of deaths. Specifically, some overdose deaths that were suicide may have been misclassified as unintentional.[44] Third, we only examined unintentional overdose deaths that involved an opioid. However, in the 2019 NC-SUDORS data, there were only 2 unintentional overdose deaths during pregnancy and the first year postpartum that did not involve an opioid. Fourth, our analyses were limited to 2 years of pre-COVID-19 pandemic data in one state. Given variation in MMRC composition and processes and differences in programmatic and policy responses to pregnancy-associated deaths across states, we focused on one state, North Carolina. Our objective was to develop an approach to quantifying homicide, suicide, and overdose deaths during pregnancy and postpartum that can serve as a framework for other states. Further analyses are needed in additional states and with more recent data when available. Last, final NC-MMRC determinations for 2018–2019 are not yet available. Thus, we do not yet have information on whether the NC-MMRC considered these deaths to be pregnancy-related or preventable, and we do not yet have NC-MMRC recommendations for prevention based on these data. Once finalized, future research may benefit from review of narrative information included in the NC-MMRC, NC-VDRS, and NC-SUODRS data to further contextualize quantitative results.

Conclusions

Data-driven strategies to reduce rates of death during pregnancy and the first year postpartum are urgently needed. Sharing information across surveillance systems to identify pregnancy-associated homicide, suicide, and overdose deaths can provide more timely and comprehensive information to better inform prevention efforts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Review to Actoin. Definitions. 2023. Retireved from https://reviewtoaction.org/learn/definitions.
2. Centers for Disease Control and Prevention National Center for Health Statistics. Maternal Mortality: Detailed Evaluation of Changes in Data Collection Methods. 2019. Retrieved from https://www.cdc.gov/nchs/maternal-mortality/evaluation.htm
3. Margerison CE, Roberts MH, Gemmill A, Goldman-Mellor S. Pregnancy-associated deaths due to drugs, suicide, and homicide in the United States, 2010–2019. Obstetrics & Gynecology. 2022;139(2):172–180. [PubMed: 34991132]
4. Wallace ME, Hoyert D, Williams C, Mendola P. Pregnancy-associated homicide and suicide in 37 US states with enhanced pregnancy surveillance. American Journal of Obstetrics & Gynecology. 2016;215(3):364–e1.
5. Margerison CE, Wang X, Gemmill A, Goldman-Mellor S. Changes in pregnancy-associated deaths in the US during the COVID-19 pandemic in 2020. JAMA Network Open. 2023;6(2):e2254287–e2254287. [PubMed: 36723945]
6. Bruzelius E, Martins SS. US Trends in Drug Overdose Mortality Among Pregnant and Postpartum Persons, 2017–2020. JAMA. 2022;328(21):2159–2161. [PubMed: 36472602]
7. Wallace ME. Trends in pregnancy-associated homicide, United States, 2020. American Journal of Public Health. 2022;112(9):1333–1336. [PubMed: 35797500]
8. Trost S, Beauregard J, Chandra G, et al. Pregnancy-related deaths: Data from Maternal Mortality Review Committees in 36 States, 2017–2019. Education. 2022;45(10):1–0.
9. Centers for Disease Control and Prevention, National Vital Statistics System. A Reference Guide for Certification of Deaths Associated With Pregnancy on Death Certificates. 2022 Retrieved from https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg004.pdf
10. Catalano A, Davis NL, Petersen EE, et al. Pregnant? Validity of the pregnancy checkbox on death certificates in four states, and characteristics associated with pregnancy checkbox errors. American Journal of Obstetrics & Gynecology. 2020;222(3):269–e1.
11. Horon IL, Cheng D. Enhanced surveillance for pregnancy-associated mortality—Maryland, 1993–1998. JAMA. 2001;285(11):1455–1459. [PubMed: 11255421]
12. Enhancing Reviews and Surveillance to Eliminate Maternal Mortality. Process of a Review. 2023. Retrieved from https://reviewtoaction.org/implement/process-review
13. Centers for Disease Control and Prevention. Enhancing Reviews and Surveillance to Eliminate Maternal Mortality. 2022. Retrieved from https://www.cdc.gov/reproductivehealth/maternal-mortality/erase-mm/index.html
14. Centers for Disease Control and Prevention. National Violent Death Reporting System. 2023. Retrieved from https://www.cdc.gov/violenceprevention/datasources/nvdrs/index.html
15. Centers for Disease Control and Prevention. CDC's State Unintentional Drug Overdose Reporting System (SUDORS). 2022. Retrieved from https://www.cdc.gov/drugoverdose/fatal/sudors.html
16. Miller JM, Rensing S. Integrating National Violent Death Reporting System data into maternal mortality review committees. Journal of Women's Health. 2021;30(11):1573–1579.
17. Smid MC, Stone N, Baksh L, et al. Pregnancy-associated death in Utah: contribution of drug-induced deaths. Obstetrics and Gynecology. 2019;133(6):1131. [PubMed: 31135726]
18. North Carolina Division of Public Health Injury and Violence Prevention Branch. North Carolina Violent Death Reporting System. 2023. Retrieved from https://injuryfreenc.dph.ncdhhs.gov/About/ncVDRS.htm
19. Centers for Disease Control and Prevention. State Unintentional Drug Overdose Reporting System (SUDORS). 2022. Retrieved from https://www.cdc.gov/drugoverdose/fatal/sudors.html
20. Shiue KY, Austin AE, Proescholdbell S, Cox ME, Aurelius M, Naumann RB. Literal text analysis of poly-class and polydrug overdose deaths in North Carolina, 2015–2019. Drug and Alcohol Dependence. 2021;228:109048.
21. Centers for Disease Control and Prevention. National Violent Death Reporting System Web Coding Manual. 2022. Retrieved from https://www.cdc.gov/violenceprevention/pdf/nvdrs/nvdrsCodingManual.pdf.

22. Centers for Disease Control and Prevention National Vital Statistics System. Natality Information: Live Births. 2022. Retrieved from https://wonder.cdc.gov/natality.html
23. Austin AE, Vladutiu CJ, Jones-Vessey KA, Norwood TS, Proescholdbell SK, Menard MK. Improved ascertainment of pregnancy-associated suicides and homicides in North Carolina. American journal of Preventive Medicine. 2016;51(5):S234–S240. [PubMed: 27745612]
24. Modest AM, Prater LC, Joseph NT. Pregnancy-associated homicide and suicide: An analysis of the national violent death reporting system, 2008–2019. Obstetrics & Gynecology. 2022;140(4):565–573. [PubMed: 36075083]
25. Kozhimannil KB, Lewis VA, Interrante JD, Chastain PL, Admon L. Screening for and Experiences of Intimate Partner Violence in the United States Before, During, and After Pregnancy, 2016–2019. American Journal of Public Health. 2023;113(3):297–305. [PubMed: 36701660]
26. Kivisto AJ, Mills S, Elwood LS. Racial disparities in pregnancy-associated intimate partner homicide. Journal of Interpersonal Violence. 2022;37(13–14):NP10938–NP10961. [PubMed: 33527866]
27. Sivaraman JJ, Ranapurwala SI, Moracco KE, Marshall SW. Association of state firearm legislation with female intimate partner homicide. American Journal of Preventive Medicine. 2019;56(1):125–133. [PubMed: 30573141]
28. Díez C, Kurland RP, Rothman EF, et al. State intimate partner violence–related firearm laws and intimate partner homicide rates in the United States, 1991 to 2015. Annals of Internal Medicine. 2017;167(8):536–543. [PubMed: 28975202]
29. Tabb KM, Dalton VK, Tilea A, et al. Trends in antenatal depression and suicidal ideation diagnoses among commercially insured childbearing individuals in the United States, 2008– 2018. Journal of Affective Disorders. 2023;320:263–267. [PubMed: 36179783]
30. Metz TD, Rovner P, Hoffman MC, Allshouse AA, Beckwith KM, Binswanger IA. Maternal deaths from suicide and overdose in Colorado, 2004–2012. Obstetrics & Gynecology. 2016;128(6):1233. [PubMed: 27824771]
31. American College of Obstetricians and Gynecologists. Screening for perinatal depression. Obstetrics & Gynecology. 2018;132(5):208–212.
32. Moore JE, McLemore MR, Glenn N, Zivin K. Policy Opportunities To Improve Prevention, Diagnosis, And Treatment Of Perinatal Mental Health Conditions: Study examines policy opportunities to improve prevention, diagnosis, and treatment of perinatal mental health. Health Affairs. 2021;40(10):1534–1542. [PubMed: 34606359]
33. Jarlenski M, Chen Q, Gao A, Rothenberger SD, Krans EE. Association of duration of methadone or buprenorphine use during pregnancy with risk of nonfatal drug overdose among pregnant persons with opioid use disorder in the US. JAMA Network Open. 2022;5(4):e227964–e227964. [PubMed: 35438758]
34. Austin AE, Durrance CP, Ahrens KA, et al. Duration of medication for opioid use disorder during pregnancy and postpartum by race/ethnicity: Results from 6 state Medicaid programs. Drug and Alcohol Dependence. 2023;247:109868.
35. Stone R. Pregnant women and substance use: Fear, stigma, and barriers to care. Health & Justice. 2015;3(1):2.
36. Austin AE, Naumann RB, Simmons E. Association of state child abuse policies and mandated reporting policies with prenatal and postpartum care among women who engaged in substance use during pregnancy. JAMA Pediatrics. 2022;176(11):1123–1130. [PubMed: 36121649]
37. Gressler LE, Shah S, Shaya FT. Association of criminal statutes for opioid use disorder with prevalence and treatment among pregnant women with commercial insurance in the United States. JAMA Network Open. 2019;2(3):e190338–e190338. [PubMed: 30848807]
38. Faherty LJ, Stein BD, Terplan M. Consensus guidelines and state policies: the gap between principle and practice at the intersection of substance use and pregnancy. American Journal of Obstetrics & Gynecology. 2020;2(3):100137.
39. Weber A, Miskle B, Lynch A, Arndt S, Acion L. Substance use in pregnancy: identifying stigma and improving care. Substance Abuse and Rehabilitation. 2021:105–121. [PubMed: 34849047]

40. Legislative Analysis and Public Policy Association. Model Expanded Access to Emergency Opioid Antagonists. 2021. Retrieved from http://www.legislativeanalysis.org/wp-content/uploads/2021/11/Model-Expanded-Access-to-Emergency-Opioid-Antagonists-Act-FINAL.pdf

41. Campbell J, Matoff-Stepp S, Velez ML, Cox HH, Laughon K. Pregnancy-associated deaths from homicide, suicide, and drug overdose: review of research and the intersection with intimate partner violence. Journal of Women's Health. 2021;30(2):236–44.

42. Bronson J, Reviere R. Pregnancy-associated deaths in Virginia due to homicides, suicides, and accidental overdoses compared with natural causes. Violence Against Women. 2017;23(13):1620–37. [PubMed: 27586171]

43. Mehta PK, Bachhuber MA, Hoffman R, Srinivas SK. Deaths from unintentional injury, homicide, and suicide during or within 1 year of pregnancy in Philadelphia. American Journal of Public Health. 2016;106(12):2208–10. [PubMed: 27736205]

44. Rockett IRH, Kapusta ND, Coben JH. Beyond suicide: action needed to improve self-injury mortality accounting. JAMA Psychiatry. 2014;71(3):231–232. [PubMed: 24382750]

What is already known on this topic:

Rates of death due to homicide, suicide, and overdose during pregnancy and postpartum are increasing in the U.S.

What this study adds:

Novel use of data from three statewide surveillance systems, the North Carolina Maternal Mortality Review, Violent Death Reporting System, and Statewide Unintentional Drug Overdose Reporting System, to improve the timeliness and comprehensiveness on the characteristics of and circumstances surrounding homicide, suicide, and overdose deaths during pregnancy and postpartum.

How this study might affect research, practice, or policy:

Given that the North Carolina Violent Death Reporting System and Statewide Unintentional Drug Overdose Reporting Systems are more timely, while the North Carolina Maternal Mortality Review more accurately identified all deaths during pregnancy and postpartum, data sharing between surveillance systems is critical to informing data-driven prevention.

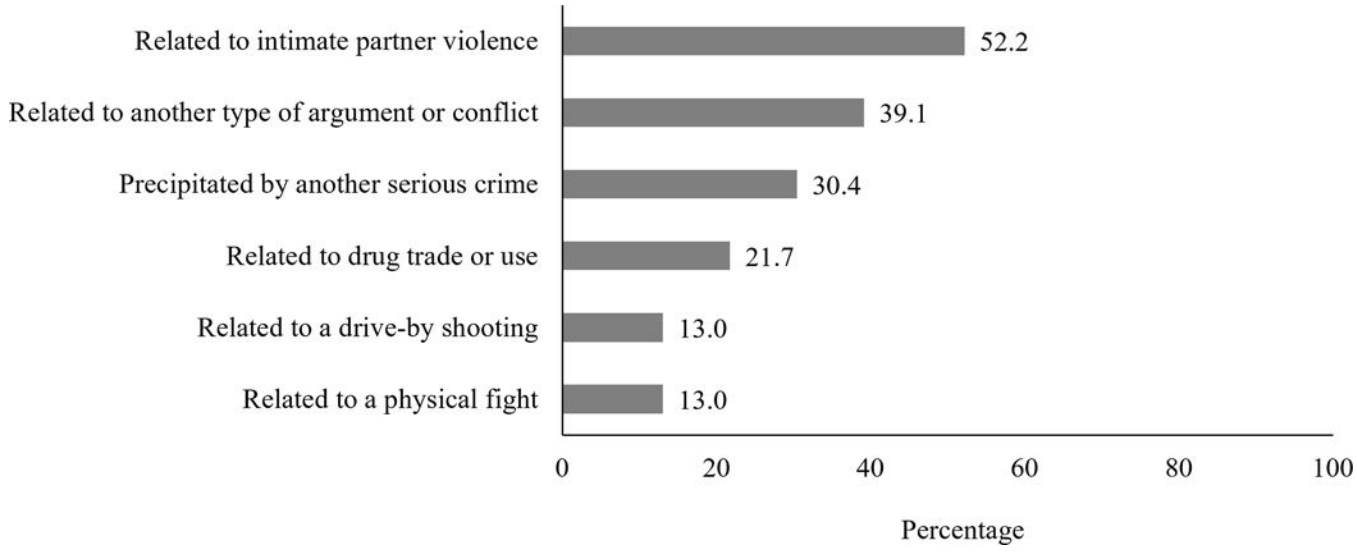

Figure 1.

Circumstances surrounding homicide deaths[a] during pregnancy and the first year postpartum, North Carolina 2018–2019 (N=23) [a]Circumstances as recorded in the North Carolina Violent Death Reporting System. Circumstances are not mutually exclusive. See online Supplemental Table 2 for definitions.

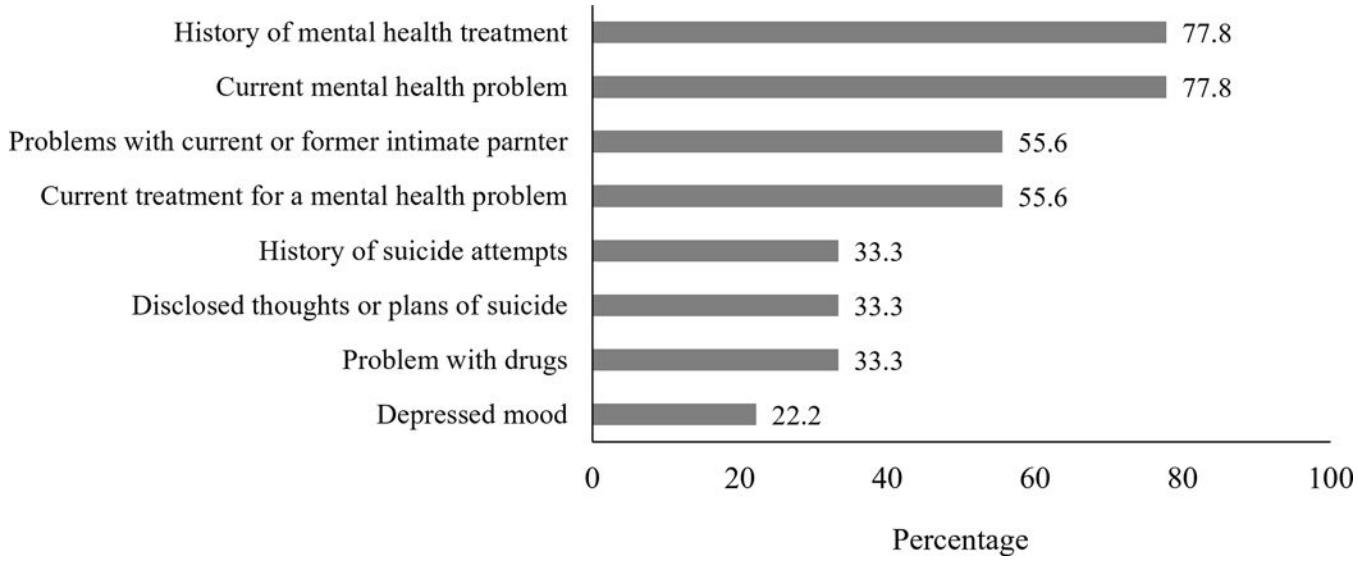

Figure 2.

Circumstances surrounding suicide deaths[a] during pregnancy and the first year postpartum, North Carolina 2018–2019 (N=9) [a]Circumstances as recorded in the North Carolina Violent Death Reporting System. Circumstances are not mutually exclusive. See online Supplemental Table 2 for definitions.

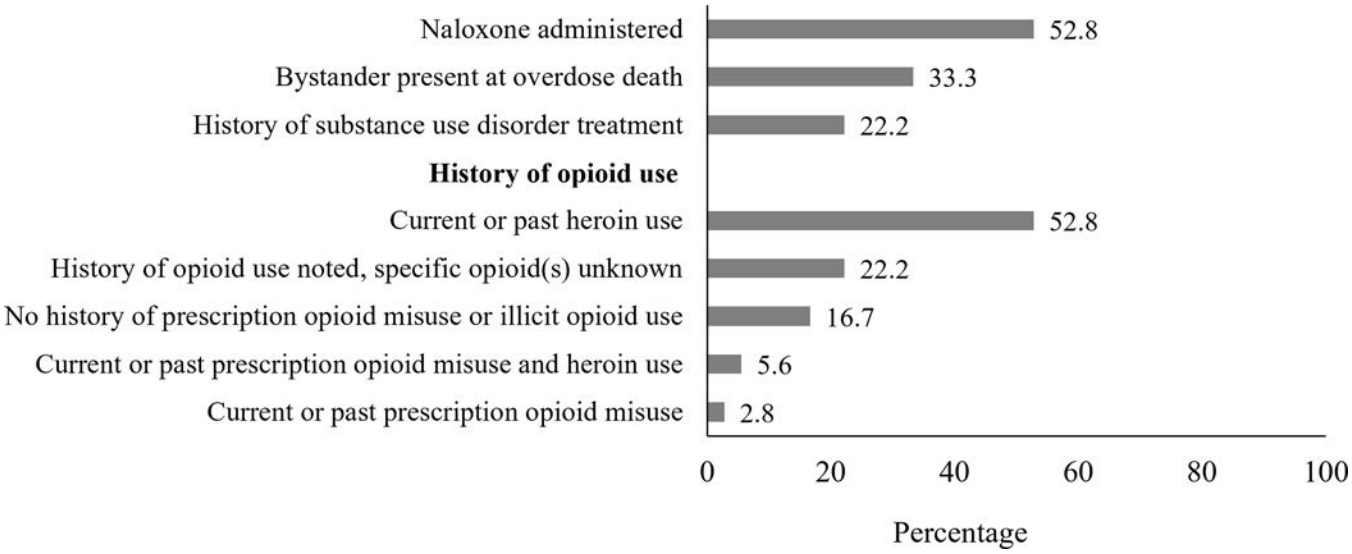

Figure 3.

Circumstances surrounding unintentional opioid-involved overdose deaths[a] during pregnancy and the first year postpartum, North Carolina 2018–2019 (N=36) [a]Circumstances as recorded in the North Carolina Statewide Unintentional Drug Overdose Surveillance System. Circumstances are not mutually exclusive. See Supplemental Table 2 for definitions. Note: Among deaths with naloxone administered (N=19), 57.9% of administrations were by law enforcement, emergency medical services, or hospital staff, 36.8% of administration were by another type of responder, and 5.3% of administrations were by a bystander.

Table 1.

Demographic and other characteristics of homicide, suicide, and unintentional opioid-involved overdose deaths during pregnancy and the first year postpartum, North Carolina 2018–2019

	Homicide (N=23)		Suicide (N=9)		Unintentional opioid-involved overdose (N=36)	
	N	%	N	%	N	%
Age (years)						
15–24	14	60.9	5	55.6	6	16.7
25–29	6	26.1	3	33.3	10	27.8
30–34	2	8.7	1	11.1	12	33.3
35–39	1	4.4	0	0.0	6	16.7
40–44	0	0.0	0	0.0	2	5.6
Race and ethnicity						
American Indian/Alaska Native	2	8.7	0	0.0	3	8.3
Asian/Pacific Islander	1	4.4	0	0.0	0	0.0
Black non-Hispanic	17	73.9	2	22.2	3	8.3
Hispanic	1	4.4	1	11.1	3	8.3
White non-Hispanic	2	8.7	6	66.7	27	75.0
Education						
Less than high school	5	21.7	1	11.1	13	36.1
High school or GED	12	52.2	5	55.6	12	33.3
Some college	5	21.7	2	22.2	5	13.9
Associate’s, Bachelor’s, or more	1	4.4	1	11.1	6	16.7
Timing of death						
Pregnancy	7	30.4	3	33.3	4	11.1
Early postpartum (1–42 days)	2	8.7	1	11.1	2	5.6
Late postpartum (≥43 days)	14	60.9	5	55.6	30	83.3
Method of homicide and suicide deaths						
Firearm	20	87.0	2	22.2	–	–
Sharp instrument	3	13.0	0	0.0	–	–
Hanging, strangulation, or suffocation	0	0.0	5	55.6	–	–
Poisoning	0	0.0	1	11.1	–	–
Fall	0	0.0	1	11.1	–	–
Drugs contributing opioid-involved overdose deaths						
Fentanyl	–	–	–	–	29	80.6
Heroin	–	–	–	–	15	41.7
Cocaine	–	–	–	–	14	38.9
Alprazolam	–	–	–	–	7	19.4
Methamphetamine	–	–	–	–	4	11.1
Oxycodone	–	–	–	–	4	11.1
Gabapentin	–	–	–	–	4	11.1
Methadone	–	–	–	–	3	8.3

	Homicide (N=23)		Suicide (N=9)		Unintentional opioid-involved overdose (N=36)	
	N	%	N	%	N	%
Diazepam	–	–	–	–	2	5.6
Unspecified opioid					2	5.6