Improved Ascertainment of Pregnancy-Associated Suicides and Homicides in North Carolina

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Abstract

Introduction—Injuries, including those resulting from violence, are a leading cause of death during pregnancy and the postpartum period. North Carolina, along with other states, has implemented surveillance systems to improve reporting of maternal deaths, but their ability to capture violent deaths is unknown. The purpose of this study was to quantify the improvement in ascertainment of pregnancy-associated suicides and homicides by linking data from the North Carolina Violent Death Reporting System (NC-VDRS) to traditional maternal mortality surveillance files.

Methods—Enhanced case ascertainment was used to identify suicides and homicides that occurred during or up to 1 year after pregnancy from 2005 to 2011 in North Carolina. NC-VDRS data were linked to traditional maternal mortality surveillance files (i.e., death certificates with any mention of pregnancy or matched to a live birth or fetal death record and hospital discharge records for women who died in the hospital with a pregnancy-related diagnosis). Mortality ratios were calculated by case ascertainment method. Analyses were conducted in 2015.

Results—A total of 29 suicides and 55 homicides were identified among pregnant and postpartum women through enhanced case ascertainment as compared with 20 and 34,

respectively, from traditional case ascertainment. Linkage to NC-VDRS captured 55.6% more pregnancy-associated violent deaths than traditional surveillance alone, resulting in higher mortality ratios for suicide (2.3 vs 3.3 deaths per 100,000 live births) and homicide (3.9 vs 6.2 deaths per 100,000 live births).

Conclusions—Linking traditional maternal mortality files to NC-VDRS provided a notable improvement in ascertainment of pregnancy-associated violent deaths.

Introduction

Injuries, including those resulting from violence, are a leading cause of death and disability among women of reproductive age in the U.S.[1] In particular, suicide and homicide have been noted as leading causes of death during pregnancy and the postpartum period.[2–8] These violent deaths are often classified as pregnancy-associated (i.e., deaths occurring while pregnant or within 1 year of termination of pregnancy, irrespective of cause), but in some cases the cause of death may be related to pregnancy such as suicide related to postpartum depression and some homicides related to intimate partner violence (IPV).[9]

The Centers for Disease Control and Prevention (CDC) first implemented a national maternal mortality surveillance system in 1986 to improve reporting of pregnancy-related deaths, address data gaps in the causes of these deaths, and inform prevention and intervention.[10] Data are collected on all deaths occurring during pregnancy or within 1 year of pregnancy, regardless of cause, and all deaths are reviewed to determine if the cause of death is related to pregnancy.[11] Several states, including North Carolina, have implemented maternal mortality surveillance systems that rely on administrative databases such as vital records, medical charts, and hospital discharge reports.[12] However, these databases often lack detailed information on the circumstances surrounding deaths, and their ability to capture all violent deaths during pregnancy and the postpartum period is unknown.[9,13,14] Additional data sources are needed to identify violent deaths missed by traditional surveillance and to provide further information for understanding if the cause of death was related to pregnancy.

CDC's National Violent Death Reporting System (NVDRS) captures detailed data on all suicides, homicides, deaths of undetermined intent, unintentional firearm deaths, and deaths due to legal intervention occurring in 32 states, including North Carolina.[15] The inclusion of NVDRS in traditional maternal mortality surveillance systems may improve reporting of pregnancy-associated violent deaths and identification of cases in which the cause of death was related to pregnancy. This information is important for informing the development and implementation of violence prevention strategies during pregnancy and the postpartum period. The objectives of this study were to use an enhanced case ascertainment process of linked data from the North Carolina Violent Death Reporting System (NC-VDRS) and traditional maternal mortality surveillance files to estimate the frequency of pregnancy-associated suicides and homicides in North Carolina and to describe the circumstances surrounding these violent deaths.

Methods

Data Sources

Suicides and homicides were identified from two data sources: maternal mortality files and NC-VDRS. North Carolina's maternal mortality files include information on maternal deaths for women aged 10–50 years occurring during pregnancy and up to 1 year following delivery (i.e., traditional ascertainment). The North Carolina State Center for Health Statistics identifies deaths annually using death certificates with any mention of pregnancy or with relevant ICD-10 cause of death codes. Additionally, all death records for women aged 10–50 years are electronically matched to live birth and fetal death certificates for the same and previous calendar year to identify other maternal deaths. Hospital discharge records are also queried for women who died in a North Carolina inpatient hospital with a pregnancy-related diagnosis. Clinical experts review the cases to confirm classification as pregnancy-related. For 2005–2011, a detailed medical review was conducted by a board-certified obstetrician specializing in maternal and fetal medicine. If there was insufficient information to classify the death, the medical examiner or physician signing the death certificate was contacted for additional information (e.g., autopsy report).[16]

The NC-VDRS is part of CDC's NVDRS. It is an incident-based, statewide surveillance system administered by the Injury and Violence Prevention Branch of the North Carolina Division of Public Health. NC-VDRS collects data on all violent deaths that occur in North Carolina by combining data from death certificates, medical examiner reports, and law enforcement incident and investigative reports. The victim's pregnancy or postpartum status is noted on the death certificate or in the medical examiner's autopsy report and is coded as pregnant at the time of death, pregnant within 42 days of death, pregnant within 43 days to 1 year before death, or unknown if pregnant within the past year.

News reports were used as an additional source of information to determine gestational age at the time of death.

Enhanced Case Ascertainment

An enhanced case ascertainment process was used to identify women who were North Carolina residents and died from suicide or homicide during pregnancy or the postpartum period from 2005 to 2011. Individual NC-VDRS files for women aged 10–50 years were deterministically linked to maternal mortality files using death certificate number and year of death. A manual review of all matches was conducted to ensure linkage accuracy. All maternal deaths coded as suicide or homicide in the maternal mortality files linked to a record in NC-VDRS, yielding a 100% match rate. NC-VDRS files were also queried for pregnancy status to ascertain additional pregnancy-associated deaths that were not included in the maternal mortality files from traditional case ascertainment. The University of North Carolina at Chapel Hill IRB considered this study exempt.

Measures

Victim characteristics included age, race (black, white, other), marital status (never married, married), and years of education (categorized as <12 years, 12 years). Data on education

are only provided for 2005–2009, owing to changes in birth certificate data collection in 2010. Data for victim characteristics were obtained from NC-VDRS.

The method (e.g., firearm, poisoning) of suicide and homicide was reported in NC-VDRS and based on ICD-10 codes derived from death certificates and information in the medical examiner and law enforcement reports. Circumstances were reported in NC-VDRS and were based on information in the medical examiner and law enforcement reports. Suicide circumstances included if the victim was perceived by herself, family, or friends to have been depressed at the time of death; had one or more known mental health diagnoses other than alcohol or substance abuse; had a current prescription for a psychiatric medication or had seen a mental health professional within the past month; and whether the suicide was related to problems with a current or former intimate partner or other interpersonal problems with family or friends. Homicide circumstances included whether the incident was related to IPV; jealousy or distress over an intimate partner's relationship or suspected relationship with another person; an argument or other interpersonal conflict not related to IPV, jealousy, money, or property; drug dealing or illegal use; if the homicide was precipitated by another serious crime such as robbery or sexual assault; and the relationship of the victim to the suspect.

For pregnant suicide and homicide victims, the weeks of gestation at the time of death were noted in the NC-VDRS incident narrative if provided in the medical examiner report or were obtained from news reports if not included in NC-VDRS (n=8). For postpartum victims, the number of months post-delivery at death was calculated by comparing the date of delivery as noted in the maternal mortality files to the date of death as noted in NC-VDRS.

Statistical Analysis

Descriptive analyses were conducted to calculate the number of suicides and homicides occurring during pregnancy or the postpartum period and overall mortality ratios (per 100,000 live births) by case ascertainment method (traditional versus enhanced). Maternal mortality ratios were defined as the number of violent deaths divided by the number of live births among North Carolina residents. Suicide and homicide mortality ratios were also estimated by victim characteristics for cases identified through enhanced case ascertainment. Additional analyses examined circumstances, methods, and time of death by pregnant and postpartum status. Analyses were conducted in 2015.

Results

Between 2005 and 2011, 20 suicides and 34 homicides were identified among pregnant and postpartum women through traditional case ascertainment, and all were matched to a record in NC-VDRS. An additional nine suicides and 21 homicides were identified by NC-VDRS for a total of 29 suicides and 55 homicides identified through enhanced case ascertainment (Figure 1). Linkage to NC-VDRS captured 55.6% more pregnancy-associated violent deaths than traditional surveillance. Twenty-six of the 30 (86.7%) additional deaths identified through enhanced case ascertainment occurred during pregnancy; four (13.3%) occurred during the postpartum period. The additional deaths identified through enhanced case ascertainment resulted in higher overall suicide (2.3 vs 3.3 deaths per 100,000 live births)

and homicide (3.9 vs 6.2 deaths per 100,000 live births) mortality ratios as compared with traditional ascertainment (data not shown).

Demographic characteristics of victims identified through traditional case ascertainment were similar to those identified in NC-VDRS only, with two exceptions. Among homicide victims, a higher proportion identified through traditional case ascertainment was black (61.8%), whereas a higher proportion identified in NC-VDRS only was white (57.1%). Among suicide victims, a higher proportion identified through traditional case ascertainment was not married (55%), whereas a higher proportion identified in NC-VDRS only was married (66.7%).

Among violent deaths identified through enhanced case ascertainment, pregnant and postpartum women aged 35 years had a higher suicide mortality ratio than women aged 10–34 years (8.9 vs 2.5 deaths per 100,000 live births, Table 1). For homicides, pregnant and postpartum women aged 10–34 years had a higher mortality ratio than women aged 35 years (6.8 vs 2.7 deaths per 100,000 live births), black women had a higher mortality ratio than white women (14.5 vs 5.1 deaths per 100,000 live births), unmarried women had a higher mortality ratio than married women (11.1 vs 2.9 deaths per 100,000 live births), and women with < 12 years of education had a higher mortality ratio than women with 12 years of education (11.1 vs 5.7 deaths per 100,000 live births).

A substantial proportion of both pregnant and postpartum suicide victims were reported to have circumstances related to mental health, including a current mental health diagnosis, receiving mental health treatment, or a current depressed mood (Table 2). The most common mental health diagnosis among pregnant women was bipolar disorder (66.7%) and among postpartum women was depression (55.6%, data not shown). Additional suicide circumstances for both pregnant and postpartum victims were related to interpersonal relationships, including problems with an intimate partner. Among pregnant women, the most common method of suicide was hanging, strangulation, or suffocation (42.9%), whereas the most common method among postpartum women was a firearm (54.5%).

More than half of pregnant suicide victims were 1–12 weeks of gestation at the time of death (57.1%). Most postpartum suicide victims were 3 months post-delivery at the time of death (77 3%)

The most frequently reported circumstances for both pregnant and postpartum homicide victims were related to interpersonal relationships, including problems with an intimate partner and jealousy or lovers' triangle (Table 3). A high proportion of pregnant (44.4%) and postpartum (82.1%) homicides was perpetrated by a current or former intimate partner of the victim, such as a boyfriend, girlfriend, or spouse (data not shown). Firearms (55.6%) and sharp instruments (18.5%) were the most commonly reported methods of homicide among pregnant women (55.6% and 18.5%, respectively) and postpartum women (57.1% and 21.5%, respectively).

Two thirds of pregnant homicide victims were <28 weeks gestation at the time of death. More than half of postpartum homicide victims (53.6%) were 6 months post-delivery at the time of death.

Discussion

This study extends the literature on maternal mortality due to violence by linking state-based maternal mortality files to data from NC-VDRS to improve case ascertainment of pregnancy-associated violent deaths and to provide more detailed information regarding circumstances surrounding the deaths. Enhanced case ascertainment captured 55.6% more violent deaths and resulted in higher maternal mortality ratios for suicide and homicide than traditional case ascertainment. Most of the additional deaths identified through enhanced case ascertainment occurred during pregnancy, indicating that linkage to NC-VDRS was particularly useful in identifying violent deaths during this period. The maternal mortality ratios calculated from enhanced case ascertainment are higher than those previously published,[7] likely due to the incorporation of multiple data sources and identification of additional cases through the enhanced case ascertainment process.

There are two potential explanations for the under-ascertainment of cases using traditional case ascertainment. First, pregnancy may not have been noted on the death certificate in the cause of death fields, and thus it would not have been known whether the woman was pregnant at the time of death. The pregnancy checkbox was not added to death certificates in North Carolina until 2014 and has not been fully effective in other states in identifying pregnancy-associated deaths due to homicide and suicide.[17] Second, a live birth or fetal death certificate may not have been filed for all pregnancy-associated homicides and suicides. In North Carolina, fetal death certificates are only filed for deaths occurring after 20 weeks of gestation, thus violent deaths occurring prior to 20 weeks may have been missed by traditional case ascertainment. The inclusion of medical examiner and autopsy reports in NC-VDRS helped to identify these deaths.

Use of data from NC-VDRS only would not have been sufficient to identify all violent deaths that occurred during pregnancy and the postpartum period. The majority of the postpartum violent deaths (74.0%) identified through enhanced case ascertainment were classified as unknown if pregnant within the past year in NC-VDRS. The date of delivery from maternal mortality files was needed to correctly classify these deaths as occurring during the postpartum period. Thus, the enhanced case ascertainment process was necessary to more accurately ascertain pregnancy-associated violent deaths.

Homicide and suicide characteristics obtained from NC-VDRS included information regarding the circumstances surrounding these violent events, which is not available through traditional case ascertainment. Among pregnancy-associated suicides, the most commonly reported circumstances were related to mental health. More than half of suicide victims were reported to have one or more known mental health diagnoses. Similar findings have been reported elsewhere.[7] In this study, the majority of pregnancy-associated homicides (65.5%) were related to IPV. Previous studies have also reported IPV as a leading circumstance surrounding pregnancy-associated homicides.[4]

Information regarding the prevalence of mental health diagnoses and IPV among pregnant and postpartum suicide and homicide victims highlights the importance of screening during prenatal and postnatal visits. The American Congress of Obstetricians and Gynecologists

recommends screening for depression and anxiety symptoms using a standardized, validated tool at least once during the perinatal period.[18] In this study, most prenatal suicides occurred during the first trimester of pregnancy, thus screening during early pregnancy may be particularly important. In North Carolina, 80% of pregnant women initiate prenatal care during the first trimester, providing an opportunity for screening.[19] With regard to IPV, the American Congress of Obstetricians and Gynecologists recommends that clinicians screen women at the first prenatal visit, at least once per trimester, and at the postpartum visit.[20] In this study, more than half of the homicides among postpartum women occurred more than 6 months post-delivery, potentially indicating a need for continued vigilance beyond the first postpartum visit. From a practical standpoint, this could occur at pediatric visits for the newborn or infant.

The information provided by NC-VDRS regarding circumstances surrounding pregnancy-associated violent deaths can uncover potential causal relationships to pregnancy. In this study, 18% of suicides were known to be related to postpartum depression and 65.5% of homicides were related to IPV. Postpartum depression provides a clear link between the cause of death and pregnancy. For homicides, it is more difficult to determine whether the cause of death was related to pregnancy. It is possible that some of the homicides related to IPV may not have occurred if the victim had not been currently or recently pregnant.[6] The additional information provided by NC-VDRS regarding circumstances assists with the distinction between pregnancy-associated and -related violent deaths, which is relevant in maternal mortality surveillance.

Limitations

This study has several limitations. Although linkage to NC-VDRS substantially improved ascertainment of pregnancy-associated violent deaths, these deaths may still be under-reported. Autopsies may not have included an examination for pregnancy or may have missed women in the early stages of pregnancy. Family and friends who provided information for the medical examiner reports and law enforcement incident reports may have been unaware of early or unintended pregnancies.[8] NC-VDRS data regarding victim demographics and methods and circumstances of the violent deaths are limited to what is abstracted from the medical examiner and law enforcement reports. Information in law enforcement reports depends largely on the completeness of information provided by family and friends. The validity and reliability of the cause of death classification on the death certificates may be problematic.[21] The addition of other data sources, including medical examiner and law enforcement reports as well as birth records, helped to validate this information.[22] The denominator used to calculate the maternal mortality ratios was the number of live births. Although this is a standard denominator for these types of calculations, it is likely an underestimate of the true denominator of the total number of pregnancies, as some resulted in miscarriage or fetal death.

Conclusions

This study highlights the importance of utilizing multiple data sources to ensure accurate ascertainment of pregnancy-associated violent deaths. The findings demonstrate that case

ascertainment based solely on traditional maternal mortality files underestimates the burden of suicide and homicide during pregnancy and the postpartum period. By linking maternal mortality files to NC-VDRS, ascertainment of pregnancy-associated violent deaths is substantially improved, and further exploration to determine if the cause of death is related to pregnancy is possible. If available, the NVDRS could be routinely incorporated into maternal mortality surveillance systems to capture additional deaths due to violence and to provide a more accurate estimate of the burden and characteristics of these deaths. The gaps revealed in traditional case ascertainment for identifying pregnancy-associated violent deaths raise the question of whether maternal deaths from other causes are underestimated by this approach. State maternal mortality review teams could consider linkage of additional data sources to the maternal mortality files to improve ascertainment for other causes of pregnancy-associated death. Continually improving maternal mortality surveillance and recognizing the contribution of injury and violence to pregnancy-associated and -related deaths will aid the development of effective strategies for preventing violent deaths during pregnancy and the postpartum period.

Acknowledgments

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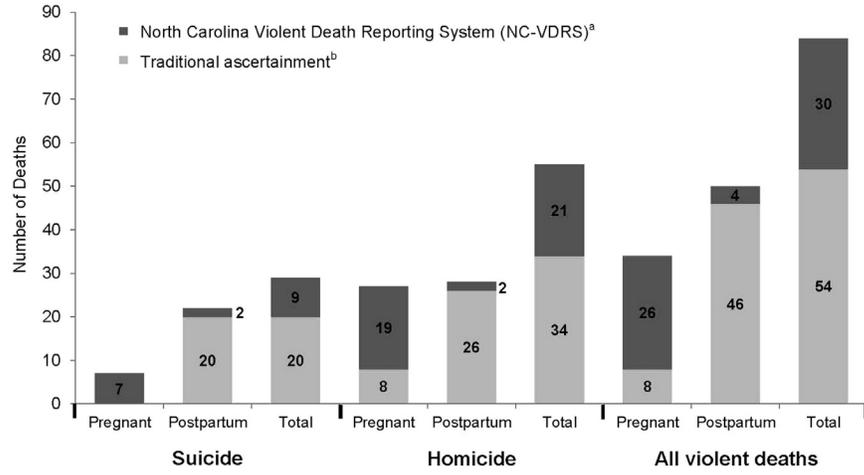
Figure 1. Suicide and homicide deaths, by pregnancy and postpartum status and data source, North Carolina, 2005–2011.

[a]NC-VDRS indicates additional violent deaths not identified in traditional ascertainment and identified only in the NC-VDRS.

[b]Traditional ascertainment defined as maternal mortality files identified from death certificates with any mention of pregnancy or matched to a live birth or fetal death record, and hospital discharge records for women who died in the hospital with a pregnancy-related diagnosis. Results of traditional ascertainment plus NC-VDRS represent enhanced case ascertainment. Enhanced case ascertainment identified 29 suicides and 55 homicides.

Table 1.

Victim Characteristics and Mortality Ratios From Enhanced Case Ascertainment, North Carolina, 2005–2011

Characteristic	Live births	Suicide victims, *n* (mortality ratio[a])	Homicide victims, *n* (mortality ratio[a])
Overall	881,820	29 (3.3)	55 (6.2)
Age, years			
10–34	768,878	19 (2.5)	52 (6.8)
35	112,893	10 (8.9)	3 (2.7)
Race			
White	492,264	22 (4.5)	25 (5.1)
Black	207,109	6 (2.9)	30 (14.5)
Other	182,447	1 (0.5)	0 (0.0)
Marital status			
Not married	361,332	14 (3.9)	40 (11.1)
Married	520,202	15 (2.9)	15 (2.9)
Education [b]			
<12 years	144,771	6 (4.1)	16 (11.1)
12 years	491,966	19 (3.9)	28 (5.7)

[a] Per 100,000 live births. Caution should be used when interpreting mortality ratios estimated with <5 deaths.

[b] The number of live births and mortality ratios for education are calculated based on 2005–2009 data only. Changes in birth certificate data collection occurred in 2010 and affected the comparability of selected variables, including education, after 2009.

Table 2.

Circumstances and Methods of Pregnancy-Associated Suicides From Enhanced Case Ascertainment (n=29), North Carolina, 2005–2011

Variable	All deaths	Pregnant	Postpartum
Overall, n	29	7	22
Circumstances[a]			
Current mental health diagnosis	16 (55.2)	2 (28.6)	14 (63.6)
Current mental health treatment	14 (48.3)	1 (14.3)	13 (59.1)
Current depressed mood	14 (48.3)	1 (14.3)	13 (59.1)
Problem with intimate partner	6 (20.7)	1 (14.3)	5 (22.7)
Other relationship problem	7 (24.1)	2 (28.6)	5 (22.7)
History of suicide attempts	4 (13.8)	1 (14.3)	3 (13.6)
Circumstances unknown	2 (6.9)	1 (14.3)	1 (4.5)
Methods			
Firearm	14 (48.3)	2 (28.6)	12 (54.5)
Poisoning	8 (27.6)	2 (28.6)	6 (27.3)
Hanging, strangulation, suffocation	7 (24.1)	3 (42.9)	4 (18.2)
Gestational age at death (weeks)			
1–12	–	4 (57.1)	–
13–27	–	1 (28.6)	–
28	–	0 (0.0)	–
Unknown	–	2 (14.3)	–
Months post-delivery at death			
0–2	–	–	3 (13.6)
3–5	–	–	9 (40.9)
6	–	–	8 (36.4)
Unknown	–	–	2 (9.1)

Note: Data are n (%) unless otherwise noted.

[a]Circumstances are not mutually exclusive.

Table 3.

Circumstances and Methods of Pregnancy-Associated Homicides From Enhanced Case Ascertainment (*n*=55), North Carolina, 2005–2011

Variable	All deaths	Pregnant	Postpartum
Overall, *n*	55	27	28
Circumstances[a]			
Intimate partner violence related	36 (65.5)	13 (48.1)	23 (82.1)
Jealousy (lovers' triangle)	5 (9.1)	1 (3.7)	4 (14.3)
Precipitated by another crime	11 (20.0)	5 (18.5)	6 (21.4)
Argument or other interpersonal conflict	7 (12.7)	5 (18.5)	2 (7.1)
Circumstances unknown	6 (10.9)	6 (22.2)	0 (0.0)
Methods			
Firearm	31 (56.4)	15 (55.6)	16 (57.1)
Sharp instrument	11 (20.0)	5 (18.5)	6 (21.4)
Hanging, strangulation, suffocation	5 (9.1)	3 (11.1)	2 (7.1)
Blunt instrument	3 (5.5)	2 (7.4)	1 (3.6)
Other/unknown	5 (9.1)	2 (7.4)	3 (10.7)
Gestational age at death (weeks)			
1–12	–	9 (33.3)	–
13–27	–	9 (33.3)	–
28	–	6 (22.2)	–
Unknown	–	3 (11.1)	–
Months post-delivery at death			
0–2	–	–	6 (21.4)
3–5	–	–	6 (21.4)
6	–	–	15 (53.6)
Unknown	–	–	1 (3.6)

Note: Data are *n* (%) unless otherwise noted.

[a]Circumstances are not mutually exclusive.