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Are Pregnant and Postpartum Women: At Increased Risk for Violent Death? Suicide and Homicide Findings from North Carolina

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Abstract The purpose of this study is to estimate rates of suicide and homicide death among pregnant, postpartum and non-pregnant/non-postpartum women ages 14–44, and to determine comparative rates of violent death for pregnant and/or postpartum women compared to non-pregnant/non-postpartum women. North Carolina surveillance and vital statistics data from 2004 to 2006 were used to examine whether pregnant or postpartum women have higher (or lower) rates of suicide and homicide compared to other reproductive-aged women. The suicide rate for pregnant women was 27% of the rate for non-pregnant/non-postpartum women (rate ratio = 0.27, 95% CI = 0.11–0.66), and the suicide rate for postpartum women was 54% of the rate for non-pregnant/non-postpartum women (rate ratio = 0.54, 95% CI = 0.31–0.95). Homicide rates also were lower for pregnant and postpartum women, with the homicide rate for pregnant women being 73% of the rate for non-pregnant/non-postpartum women (rate ratio = 0.73, 95% CI = 0.39–1.37), and the homicide rate for postpartum women being half the rate for non-pregnant/non-postpartum women (rate ratio = 0.50, 95% CI = 0.26–0.98). Although pregnant and postpartum women are at risk for homicide and suicide death, the highest risk group is non-pregnant/non-postpartum women. Violence prevention efforts should target all women of reproductive age, and pay particular attention to non-pregnant/non-postpartum women, who may have less access to health care services than pregnant and postpartum women.

Keywords Violence · Pregnancy · Postpartum · Homicide · Suicide

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Background

Fatal violence against women, including suicide and homicide, is a significant public health problem in the United States (US), especially among reproductive-aged women [1, 2]. During 2005, suicide and homicide were, respectively, the fourth and fifth leading causes of death among US women 15–44 years old [1].

Suicide Risk Among Pregnant/Postpartum Women

One reason to be concerned about suicide risk among pregnant and postpartum women is because they have been found to have high levels of depressive symptoms, which

may increase suicide risk. Depression is a known predictor of suicidality that can affect between 10 and 25% of pregnant and postpartum women [3–7]. Depressive symptoms tend to increase in severity throughout the term of pregnancy and are particularly acute during the postpartum period [8–11].

Studies examining suicidality among pregnant and postpartum women have demonstrated an extant threat for this population. The prevalence of reported "thoughts of self-harm" has been estimated to be as high as 15% in pregnant, and 14% in postpartum, populations; however, one comparison study found that rates of suicidality among postpartum women were less than half that of comparable, non-postpartum women [12–15]. Although studies measuring suicidality among pregnant and postpartum populations have found that rates of self-harm may be lower among this group when compared to non-pregnant/non-postpartum women, other studies measuring completed suicide show that suicide accounts for 1–20% of total deaths of pregnant or postpartum women [16–34].

Despite the potential risk of suicide among pregnant and postpartum groups indicated by rates of depression and suicidality, the three US-based studies which have examined women's risk of completed suicide during pregnancy and the postpartum period show either the same, or lower, rates of suicide among pregnant/postpartum women when compared to non-pregnant/non-postpartum women. The first study, based in New York City from 1987 to 1991, used vital statistics and computerized mortality tapes, and found that the observed number ($n = 10$) of suicides of pregnant women was not significantly different from the number ($n = 16.1$) expected by chance [20]. Another New York City investigation studied medical examiner records for 315 female suicide victims (aged 10–44 years old) that occurred during 1990–1993 [34]. The rate of suicide among pregnant women in this study was approximately one-third of the rate among non-pregnant women, a statistically significant difference. A Tennessee-based study during 1989–1991 examined the role of postpartum status on women's risk of suicide by linking death certificates of female residents (aged 15–44) to birth and fetal death certificates to identify suicide victims who experienced a live birth or fetal death during the year before their death [28]. Results showed that there were 3.2 suicides per 100,000 postpartum women and 6.1 suicides per 100,000 non-postpartum women, rates that were not statistically different.

Homicide Risk Among Pregnant/Postpartum Women

Studies have shown that pregnant women and women who have recently been pregnant can be victims of violence. This violence may result in physical injury, chronic disease, psychological trauma, substance use and even death [35–41]. The prevalence of physical abuse during pregnancy has been estimated to range from 1 to 22%, while the prevalence of abuse during the postpartum period has been estimated to range from 3 to 25% [35, 36, 42–44]. A national study of maternal deaths in the U.S. found that homicide is a leading cause of injury-related death among pregnant women. [19]. Other similar studies show that homicide is responsible for 3–43% of the total deaths among pregnant and postpartum groups [18–22, 24–33, 40, 45–47].

As with suicide, only three studies have compared the risk of homicide for pregnant/postpartum populations to that for non-pregnant/non-postpartum populations in the US. Although these studies sometimes found elevated homicide rates among pregnant/postpartum women, these differences did not reach the level of statistical significance. The previously described New York City investigation, conducted by Dannenberg and colleagues, showed that the observed number ($n = 71$) of pregnant homicides was not significantly different from the number ($n = 56.5$) expected by chance. However, among black pregnant women, the observed number ($n = 44$) of homicides was significantly greater than the number ($n = 28.8$) expected by chance. A Georgia-based study examined the role of postpartum status on women's risk of homicide from 1990 to 1992 by linking death certificates of female Georgia residents (aged 15–44) with birth and fetal death certificates to identify women who had a live birth or fetal death during the year before their homicide [47]. Overall, postpartum women did not have a significantly different risk of dying from homicide compared to non-pregnant/non-postpartum women; however, among postpartum teenagers (aged 15–19), the risk of homicide was significantly increased relative to other teenagers. Finally, the previously described Tennessee study by Jocums and colleagues also examined the role of postpartum status on reproductive-aged [15–44] women's rate of homicide. The researchers estimated that, in Tennessee during 1989–1991, there were 8.6 homicides per 100,000 postpartum women and 6.4 homicides per 100,000 non-postpartum women; however, these rates were not statistically different.

While a few studies have addressed the question of whether being pregnant or postpartum increases reproductive-aged women's risk of suicide or homicide, they have several limitations. None of these published studies evaluates the question using a statewide population of pregnant women *and* postpartum women, and non-pregnant/non-postpartum women. Among the studies of suicide, two (in New York City) focused only on urban populations of pregnant women compared to non-pregnant women, while the third (in Tennessee) examined only women in the postpartum period and not in the postpartum

period. Likewise with the homicide studies, one looked only at pregnant women in an urban setting, while the other two focused exclusively on postpartum women. The limitations of the current studies of pregnancy-associated violent death leave a gap in our understanding of homicide and suicide risk during pregnancy and the postpartum period.

Given that so few studies have addressed the question of whether pregnancy and/or postpartum status increases (or decreases) women's risk of suicide and homicide relative to non-pregnant/non-postpartum women, this investigation adds to this limited body of research by analyzing North Carolina data for a 3-year period (2004–2006). This study focuses on suicide and homicide deaths among three groups of reproductive-aged women (ages 14–44): pregnant women, postpartum women, and non-pregnant/non-postpartum women. Specifically, we consider the following questions:

- How many female suicide/homicide victims in North Carolina were pregnant, postpartum, or non-pregnant/non-postpartum at the time of death?
- What are the socio-demographic characteristics of pregnant, postpartum, and non-pregnant/non-postpartum suicide/homicide victims?
- What are the suicide/homicide rates among North Carolina pregnant women, postpartum women, and non-pregnant/non-postpartum women, and are these rates significantly higher (or lower) among pregnant or postpartum women compared to non-pregnant/non-postpartum women?

Methods

Sample and Data Sources

North Carolina Violent Death Reporting System (NC-VDRS) data were used to identify all suicide and homicide deaths among women of reproductive age (aged 14–44) that occurred in North Carolina during 2004, 2005 and 2006. The NC-VDRS is a violent death surveillance system funded by the National Center for Injury Prevention and Control of the Centers for Disease Control and Prevention; it is administered by the Injury and Violence Prevention Branch of the North Carolina Division of Public Health within the North Carolina Department of Health and Human Services. This surveillance system contains information on all deaths in North Carolina that result from violence, such as suicides and homicides. It incorporates information from multiple sources, including death certificates, law enforcement reports, and medical examiner reports (which typically contain autopsy findings). In North Carolina, law enforcement personnel obtain information on suicide and homicide via multiple methods such as forensic analysis and extensive interviews with witnesses' and victims' family members. The North Carolina medical examiner makes assessments of suicide and homicide based on clinical findings during autopsy and through collaboration with law enforcement.

Several variables from the NC-VDRS are examined in this study. Some of these variables describe the socio-demographic characteristics of the violence victims, documenting their age, race, education and marital status at the time of death. NC-VDRS information also was used to describe the social relationship of the homicide suspects to the homicide victims, with these relationships being categorized as being either current/past intimate partners or someone else.

Several sources of information were used to classify the identified suicide and homicide victims into one of three mutually exclusive groups: (1) those who died during pregnancy; (2) those who died postpartum; and (3) those who died while they were neither pregnant nor postpartum. NC-VDRS data, including medical examiner autopsy information and police report information from interviews with the deceased women's family and friends, were used to determine the pregnancy status of the women at the time of death. North Carolina State Center for Health Statistics birth and fetal death certificate information was linked to the NC-VDRS data to determine the postpartum status of the women at the time of death. Women were defined as being postpartum if, during the 12 months before their death, they had delivered a live birth or fetal death (i.e., a fetus of 20 or more weeks gestation) [48]. Information was not available concerning women's histories of spontaneous or induced abortions; therefore, deaths of women who experienced these events in the 12 months prior to their deaths were not classified as postpartum deaths [49].

The NC State Center for Health Statistics provided information on the total number of pregnant women, postpartum women, and non-pregnant/non-postpartum women, aged 14–44, in North Carolina during each of the three study years. This information was used to estimate North Carolina pregnant, postpartum, and non-pregnant/non-postpartum women's person-years at risk for suicide and homicide over the three-year study period.

Analysis

Descriptive statistics were used to compute the percentages of suicide and homicide victims who were pregnant, postpartum, or non-pregnant/non-postpartum at the time of death. In addition, descriptive analyses were conducted to examine the sociodemographic characteristics of these victims (including their age, race, marital status and

education level), and to examine the social relationship of the homicide suspects to the homicide victims (current/former intimate partner vs. other). Fishers exact tests were used to compare the socio-demographic characteristics of pregnant/postpartum women and non-pregnant/non-postpartum women.

For each of four groups of North Carolina women (specifically, pregnant women, postpartum women, pregnant/postpartum women grouped together, and non-pregnant/non-postpartum women), the suicide rate per 100,000 person-years at risk for suicide was computed by dividing the observed number of suicides in each group by the number of person-years at risk for suicide in that group. Person-years at risk were computed using information on the number of women per month having live births for relevant years, and associated numbers of months at risk of suicide and homicide among pregnant, postpartum and non-pregnant/non-postpartum women.

In order to examine whether the suicide rates for pregnant women, postpartum women, and pregnant/postpartum women (combined) differed from the suicide rate for non-pregnant/non-postpartum women, suicide rate ratios and associated 95% confidence intervals (CIs) were computed using the non-pregnant/non-postpartum women as the comparison group. Similar analyses were conducted to estimate the homicide rates for North Carolina pregnant women, postpartum women, pregnant/postpartum women (combined), and non-pregnant/non-postpartum women, and to examine whether the homicide rates for North Carolina pregnant women, postpartum women, and pregnant/postpartum women (combined) differed significantly from the homicide rate for non-pregnant/non-postpartum women. The data were then stratified by age (14–29 vs. 30–44) and race (non-white vs. white) to assess possible effects of these two demographic variables.

Results

Pregnancy/Postpartum Status and Suicide

From 2004 through 2006, there were 348 suicide deaths among women aged 14–44 in North Carolina. Five (1.4%) of these suicide victims were pregnant at the time of death, 13 (3.7%) were postpartum, and the remaining 330 (94.8%) died while neither pregnant nor postpartum.

Table 1 describes the socio-demographic characteristics of the pregnant, postpartum and non-pregnant/non-postpartum suicide victims. Both pregnant and postpartum suicide victims tended to be younger than non-pregnant/non-postpartum suicide victims; pregnant/postpartum victims were significantly more likely than non-pregnant/non-postpartum victims to be in the younger age group ($P = 0.019$). Somewhat more suicide victims in each of the groups were white than non-white; however, pregnant/postpartum victims did not differ significantly from

Table 1 Socio-demographic characteristics of pregnant, postpartum, and non-pregnant/non-postpartum North Carolina suicide victims, aged 14–44 (2004–2006)

	Pregnant ($n = 5$) *n* (%)	Postpartum ($n = 13$) *n* (%)	Pregnant or postpartum ($n = 18$) *n* (%)	Non-pregnant or non-postpartum ($n = 330$) *n* (%)	Fisher's exact test *P*-value
Age					
14–29	2 (40)	9 (69)	11 (61)	107 (33)	0.019*
30–44	3 (60)	4 (31)	7 (39)	223 (60)	
Race					
Non-White	2 (40)	1 (8)	3 (17)	44(13)	0.721
White	3 (60)	12 (92)	15 (83)	286 (87)	
Marital status					
Never married	3 (60)	8 (62)	11 (61)	108 (33)	0.020†*
Married	2 (40)	5 (39)	7 (39)	138 (42)	
Divorced/ widow	0	0	0(0)	84 (26)	
Education					
<12 Years	3 (60)	3 (23)	6 (33)	65 (20)	0.224
12 Or more years	2 (40)	10 (77)	12 (67)	265 (80)	

† Never married suicide victims were compared to combined married and divorced/widow suicide victims

* Statistically significant ($P < 0.05$)

non-pregnant/non-postpartum victims in terms of race ($P = 0.721$). All non-white pregnant/postpartum victims, and the majority of non-white non-pregnant/non-postpartum victims (84%), were black women. Significantly greater percentages of pregnant/postpartum suicide victims had never married compared to non-pregnant/non-postpartum suicide victims ($P = 0.020$). Although somewhat fewer pregnant suicide victims than either postpartum or non-pregnant/non-postpartum suicide victims had at least a high school level of education, pregnant/postpartum suicide victims did not differ significantly from non-pregnant/non-postpartum suicide victims in terms of education level ($P = 0.224$).

Table 2 shows that there were 18 suicides for pregnant/postpartum women compared to 330 suicides for non-pregnant/non-postpartum women. The suicide rate was significantly lower for pregnant/postpartum women (2.77 per 100,000 person years) than for non-pregnant/non-postpartum women (6.52 per 100,000 person years), with the suicide rate for pregnant/postpartum women being approximately 43% of the suicide rate for non-pregnant/non-postpartum women (rate ratio = 0.43, 95% CI = 0.26–0.68). Partitioning the pregnant/postpartum group by pregnancy status (not shown in table) showed that the suicide rate for pregnant women was significantly lower than the suicide rate of non-pregnant/non-postpartum women (rate ratio = 0.27, 95% CI = 0.11–0.66), and that the suicide rate for postpartum women was significantly lower than the suicide rate of non-pregnant/non-postpartum women (rate ratio = 0.54, 95% CI = 0.31–0.95).

Table 2 also presents suicide rates and rate ratios, based on stratification by age and race, comparing pregnant/postpartum women to non-pregnant/non-postpartum women. When stratified by age, suicide rates for both younger (14–29 years) and older (30–44 years) pregnant/postpartum women were significantly lower than rates for their non-pregnant/non-postpartum women (rate ratio for younger women = 0.52, 95% CI = 0.32–0.86; rate ratio for older women = 0.43, 95% CI = 0.26–0.69). The stratified findings for suicide by race were similar to those found by age stratification; in particular, both non-white and white pregnant/postpartum women were significantly less likely to commit suicide than non-white or white non-pregnant/non-postpartum women (rate ratio for non-white women = 0.49, 95% CI = 0.29–0.84; rate ratio for white women = 0.41, 95% 0.26–0.66).

Pregnancy/Postpartum Status and Homicide

During 2004 through 2006, there were 266 homicides among women aged 14–44 in North Carolina. Ten (3.8%) of these homicide victims were pregnant at the time of death, 9 (3.4%) died postpartum, and the remaining 247 (92.8%) died while neither pregnant nor postpartum.

Table 3 presents the socio-demographic characteristics of the pregnant, postpartum, and non-pregnant/non-postpartum homicide victims. The majority of pregnant and postpartum victims were less than 30 years of age (100 and 78%, respectively), whereas the non-pregnant/non-postpartum homicide victims tended to be somewhat older

Table 2 Suicide rates among pregnant/postpartum and non-pregnant/non-postpartum North Carolina women aged 14–44 (2004–2006)

	Number of suicides	Person-years at risk for suicide	Suicide rate per 100,000 person-years	Rate ratio (95% CI)
All women				
Pregnant/postpartum	18	648,730	2.77	0.43 (0.26–0.68)*
Non-pregnant/non-postpartum	330	5,060,010	6.52	Referent group
Younger women [14–29]				
Pregnant/postpartum	10	424,162	2.36	0.52 (0.32–0.86)*
Non-pregnant/non-postpartum	108	2,386,877	4.52	Referent group
Older women [30–44]				
Pregnant/postpartum	8	224,568	3.56	0.43 (0.26–0.69)*
Non-pregnant/non-postpartum	222	2,673,133	8.34	Referent group
Non-White women				
Pregnant/postpartum	3	178,576	1.68	0.49 (0.29–0.84)*
Non-pregnant/non-postpartum	50	1,454,119	3.44	Referent group
White women				
Pregnant/postpartum	15	470,154	3.19	0.41 (0.26–0.66)*
Non-pregnant/non-postpartum	280	3,605,891	7.77	Referent group

* Statistically significant ($P < 0.05$)

Table 3 Socio-demographic characteristics of pregnant, postpartum, and non-pregnant/non-postpartum North Carolina homicide victims, aged 14–44 (2004–2006)

	Pregnant ($n = 10$) *n* (%)	Postpartum ($n = 9$) *n* (%)	Pregnant or postpartum ($n = 19$) *n* (%)	Non-pregnant or non-postpartum ($n = 247$) *n* (%)	Fisher's exact test *P*-value
Age					
14–29	10 (100)	7 (78)	17 (89)	106 (43)	0.000*
30–44	0 (0)	2 (22)	2 (11)	141 (57)	
Race					
Non-White	5 (50)	3 (33)	8 (42)	128 (52)	0.480
White	5 (50)	6 (67)	11 (58)	119 (48)	
Marital status					
Never married	8 (80)	5 (56)	13 (68)	120 (48)	0.085†*
Married	2 (20)	3 (33)	5 (26)	71 (29)	
Divorced/widow	0 (0)	1 (11)	1 (5)	56 (23)	
Education					
<12 Years	3 (30)	2 (22)	5 (26)	84 (34)	0.618
12 Or more years	7 (70)	7 (78)	14 (74)	163 (66)	

† Never married suicide victims were compared to combined married and divorced/widow suicide victims

* Statistically significant ($P < 0.05$)

(with 57% being 30 or more years of age); pregnant/postpartum victims were significantly more likely to be in the younger age group than non-pregnant/non-postpartum victims ($P = 0.000$). There was a smaller percentage of non-whites than whites among the postpartum homicide victims (33% non-white and 67% white), but there were similar percentages of non-whites and whites among the pregnant and non-pregnant/non-postpartum homicide victims. Comparison of pregnant/postpartum victims to non-pregnant/non-postpartum victims did not find a significant difference by race ($P = 0.48$). It should be noted that the non-white pregnant/postpartum group was comprised entirely of black women. Half or more of the homicide victims in all three groups had never been married, with this being especially pronounced among pregnant homicide victims; however, there was no significant difference in marital status between pregnant/postpartum and non-pregnant/non-postpartum victims. The majority of homicide victims in each of the three groups had at least a high school level of education, and education status did not differ significantly between pregnant/postpartum and non-pregnant/non-postpartum victims ($P = 0.618$).

Information documenting the social relationship of the suspected homicide perpetrator to the victim (not shown in table) was available for 187 (70%) of the 266 homicides, including 4 (40%) of the 10 homicides of pregnant women, 9 (100%) of the 9 homicides of postpartum women and 174 (70%) of the 247 homicides of non-pregnant/non-postpartum women. For each of these three groups, women's current/former intimate partners were the most common suspects, comprising 100% (4 of 4) of the homicide suspects among pregnant women, 78% (7 of 9) of the homicide suspects among postpartum women, and 70% (122 of 174) of the homicide suspects among non-pregnant/non-postpartum women.

Table 4 shows that there were 19 homicides for pregnant/postpartum women compared to 247 homicides for non-pregnant/non-postpartum women. The homicide rate was lower for pregnant/postpartum women (2.93 per 100,000 person years) than for non-pregnant/non-postpartum women (4.88 per 100,000 person years), with the homicide rate for pregnant/postpartum women being approximately 60% of the homicide rate for non-pregnant/non-postpartum women (rate ratio = 0.60, 95% CI = 0.38–0.96). Separating the pregnant/postpartum group by pregnancy status (not shown in table) showed that the homicide rate for postpartum women was significantly lower than the homicide rate for non-pregnant/non-postpartum women (rate ratio = 0.50, 95% CI = 0.26–0.98); the homicide rate for pregnant women was also lower than the homicide rate of non-pregnant/non-postpartum women, but these rates were not significantly different (rate ratio = 0.73, 95% CI = 0.39–1.37).

Table 4 also presents homicide rates and rate ratios, based on the stratification by age and race, comparing pregnant/postpartum women to non-pregnant/non-postpartum women. Among the younger women, there was no statistically significant difference between rates of

Table 4 Homicide rates among pregnant/postpartum and non-pregnant/non-postpartum North Carolina women aged 14–44 (2004–2006)

	Number of homicides	Person-years at risk for homicide	Homicide rate per 100,000 person-years	Rate ratio (95% CI)
All women				
Pregnant/postpartum	19	648,730	2.93	0.60 (0.38–0.96)*
Non-pregnant/non-postpartum	247	5,060,010	4.88	Referent group
Younger women [14–29]				
Pregnant/postpartum	17	424,162	4.01	0.90 (0.54–1.51)
Non-pregnant/non-postpartum	106	2,386,877	4.44	Referent group
Older women [30–44]				
Pregnant/postpartum	2	224,568	0.89	0.17 (0.04–0.68)*
Non-pregnant/non-postpartum	141	2,673,133	5.27	Referent group
Non-White women				
Pregnant/postpartum	10	178,576	5.60	0.58 (0.31–1.10)
Non-pregnant/non-postpartum	140	1,454,119	9.63	Referent group
White women				
Pregnant/postpartum	9	470,154	1.91	0.65 (0.33–1.27)
Non-pregnant/non-postpartum	107	3,605,891	2.97	Referent group

* Statistically significant ($P < 0.05$)

homicide for pregnant/postpartum women and non-pregnant/non-postpartum women (rate ratio = 0.90, 95% CI = 0.54–1.51). However, for the older group, there was a significant protective effect of age for the pregnant/postpartum group (rate ratio = 0.17, 95% CI = 0.04–0.68). In contrast, there was no evidence of interaction or confounding effects due to race. Homicide rates for both white and non-white pregnant/postpartum women were not significantly different from homicide rates for white and non-white pregnant/non-postpartum women (rate ratio for non-white women = 0.58, 95% CI = 0.31–1.10; rate ratio for white women = 0.65, 95% CI = 0.33–1.27).

Discussion

This study echoes past research that demonstrates that violence, including suicide and homicide, is an important cause of death among reproductive-aged women [1]. In particular, in North Carolina during the 3-year study period, the 614 suicides and homicides of such women comprised 11% of the 5,440 deaths of all North Carolina women aged 14–44 [48].

This study also found that being pregnant or postpartum offered some "protection" against death from suicide, a finding consistent with some past research [34]. Relatively few North Carolina suicide victims of reproductive-age were pregnant (1.4%) or postpartum (3.7%) at the time of death, and the suicide rate for pregnant/postpartum women was significantly less than the rate for other women of reproductive-age (specifically, 43% of the suicide rate of non-pregnant/non-postpartum women). In addition, the characteristics of pregnant/postpartum suicide victims differed from other non-pregnant/non-postpartum suicide victims in that the pregnant/postpartum victims tended to be younger and never married; however, stratified analyses of suicide by age showed no significant effect on suicide risk. Furthermore, there were no significant differences between pregnant/postpartum and non-pregnant/non-postpartum suicide victims when controlling for race.

Somewhat similarly, this study found that being pregnant or postpartum offers some protection against homicide. In particular, relatively few North Carolina homicide victims were pregnant (3.8%) or postpartum (3.4%) at the time of death, and the homicide rate among pregnant/postpartum women was 60% of the homicide rate among other women of reproductive-age. Stratification by age showed that there were significant differences in the characteristics of pregnant/postpartum homicide victims relative to other homicide victims; specifically, being older was strongly protective among pregnant/postpartum homicide victims (similar to the findings from Dietz et al. 1998 which showed higher rates of homicide death among younger groups). Surprisingly, there was no significant effect of race on homicide risk, contrary to previous findings which suggested that black pregnant women are at a higher risk of homicide victimization [20]. Consistent with national trends and past research on homicide perpetration [2, 38], women's intimate partners were the most common homicide suspects, regardless of the victims' pregnancy status.

These findings raise the interesting and important question of why pregnant/postpartum women in general

might be somewhat protected from suicide and homicide. Although the findings from this study cannot directly answer these questions, previous studies provide some potential explanations. For example, suicide may be lower among pregnant and postpartum women because of increased social support around the time of pregnancy, more frequent contact with health care providers or concern for the fetus or newborn child [16]. Even though pregnant and postpartum women may experience violence, studies suggest that pregnancy does not increase women's risk of violence victimization [35, 36]. Therefore, the lower risk of homicide among pregnant/postpartum women compared to non-pregnant/non-postpartum women may be reflecting less violence being directed at pregnant/postpartum women.

This research has several methodological strengths, including a large sample, an innovative method for measuring pregnancy/postpartum exposure, and comparison groups of pregnant, postpartum and non-pregnant/non-postpartum. However, some caution is warranted in interpreting the study findings in light of the methodological limitations of the study. This research cannot address questions regarding whether our research findings partially resulted from pregnancy/postpartum status influencing violent behavior directly (e.g., violence perpetrators may be less likely to commit violent acts against a pregnant women, etc.), or indirectly (e.g., pregnant and postpartum women may be more likely to utilize violence prevention services). Also, the determination of person-years at risk for violent death during pregnancy assumes a 9-month period for pregnancy, which may overestimate the length of time a woman is actually aware of her pregnancy status. This phenomenon would result in an inflation of the person-years at risk for pregnancy-associated death, thus resulting in underestimation of pregnancy-related violent death rates. Another study limitation is that it was not possible to identify a particular group of women who may be at elevated risk of domestic violence and hence violent death, namely, women who had experienced spontaneous or induced abortions within the year prior to their death [50]. As a result, these women would have been misclassified into the non-pregnant/non-postpartum group rather than correctly assigned to the postpartum group, thus resulting in an underestimated rate of violent death among postpartum women. This work is also focused solely on the state of North Carolina, limiting the generalizability of the results to other states or to the U.S. as a whole. Finally, in North Carolina, since autopsies are only required for suspicious or contested suicides [51], it is possible that some non-autopsied pregnant suicide victims were misclassified as non-pregnant/non-postpartum suicide victims. In this study, over half (54%) of all female suicide victims ages 14–44 had undergone autopsy. However, even if an autopsy was not performed on a pregnant suicide victim, the pregnancy would have been detected in the surveillance system if police interviews with the victims' relatives/friends revealed that the victim was pregnant at the time of death (note that this measure itself is affected by friends'/family's awareness of a victim's pregnancy status).

Despite the limitations of this research, these study results have implications for both violence prevention practices and violence-related research. First, since reproductive-aged women who are not pregnant/postpartum experience as high (if not higher) rates of suicide and homicide when compared to pregnant/postpartum women, interventions aimed at violence prevention (such as screening for violence in healthcare settings) should be implemented in settings used by all reproductive-aged women, not just by those who are pregnant/postpartum. Furthermore, reproductive-age women who are not pregnant or in the immediate postpartum period may be less likely than pregnant/postpartum women to have direct and regular contact with providers (such as healthcare professionals and other service providers) who often offer violence prevention interventions; therefore, outreach efforts should be aimed at identifying and serving these women appropriately. For homicide, efforts should focus on correlates of partner violence (as we saw, the majority of homicide perpetrators were women's partners). Violence prevention programs can include community-based and health-sector education, outreach and media campaigns aimed at eliminating tolerance for violence, empowering women through sexual equality, and changing community norms around gender-based violence [52]. Interventions aimed at decreasing suicide should address mental illness associated with suicidality, such as depression. Promoting programs that address depression and suicide, such as physician education, public media campaigns and screening efforts, could help lower suicide risk for all women [53].

The results of this study also have implications for future research on pregnancy-associated violence. We applaud the previous pioneering research that focused on understanding how pregnancy and postpartum status may influence women's risk of violent death. However, given that there are not many studies on this very important topic, we encourage researchers and research funders to turn their attention to this area to expand our understanding of violence against women. Our study employs publically available data and a more accurate method of accounting for person-years at risk of violent death, a strategy which can be applied to multiple settings across the US and other countries. Furthermore, North Carolina is just one state in a multi-state consortium of the Violent Death Reporting System (VDRS), which serves as an important resource for research related to suicide and homicide. By expanding this

type of research into more and broader settings, we can help provide a strong empirical foundation on which practitioners, policy makers, and others can design and implement effective violence prevention and intervention strategies to improve women's lives.

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