Pregnancy-Associated Mortality

New York City, 2011-2015

NYC Health

Pregnancy-Associated Mortality in New York City, 2011-2015

New York City Department of Health and Mental Hygiene

Bureau of Maternal, Infant and Reproductive Health in collaboration with the Bureau of Vital Statistics and the Office of the Chief Medical Examiner

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Executive Summary

Maternal mortality (i.e., a person's death during pregnancy, during labor and childbirth, or after giving birth) is a tragic experience for families and communities. It can lead to serious emotional, physical, social and financial consequences for the surviving family members, including the children who have lost their parent.[1]

During the 20th century, the United States (U.S.) experienced a dramatic decline in maternal mortality. This dramatic decline — one of the U.S.'s greatest public health achievements — is attributed to improved living standards; increased access to quality health care; the development of standardized hospital guidelines for maternity care; the increased use of antibiotics, antiseptic techniques and blood transfusions to treat hemorrhage; and abortion legalization.[2]

However, national data show a rise in maternal mortality across the U.S. in recent decades.[3,4] This trend stands in contrast to declining trends in other high-income countries.[5] In 2015, the U.S. maternal mortality ratio ranked 38 among 46 developed countries as defined by WHO.[5] Trends in the U.S. also demonstrate racial inequities in maternal mortality. Nationally, Black non-Latina women are more than three times as likely to suffer a pregnancy-related death as White non-Latina women, according to most recent data for 2011-2014.[3,6] In New York City (NYC), these inequities are even greater.

This report provides estimates of pregnancy-associated deaths (any death that occurs during pregnancy or within one year from the end of pregnancy) in NYC in 2011-2015. The report summarizes the causes and conditions of these deaths as pregnancy-related or not pregnancy-related, and provides their demographic, clinical and delivery characteristics. Pregnancy-related deaths are those pregnancy-associated deaths that were causally related to the pregnancy or its management. As in the previous New York City Department of Health and Mental Hygiene (NYC DOHMH, or the Health Department) reports, injury deaths — including substance use, homicide and suicide — are categorized as not pregnancy-related. While there could be a causal relationship between pregnancy and injury deaths, that determination was not made for injury deaths during this time period. Throughout this report, we refer to pregnancy-related deaths, maternal deaths and maternal mortality interchangeably.

The findings in this report are based on enhanced surveillance methods that have been consistently used to identify and review pregnancy-associated deaths in NYC since 2001 (see Methodology).[7] The Health Department — in close collaboration with the Office of the Chief Medical Examiner (OCME) — performs this surveillance. It involves a comprehensive search and linkage of multiple data sources including vital records, inpatient hospital discharge data and medical examiner reports to identify all women in NYC who died during pregnancy or within one year of the end

of the pregnancy from any cause (i.e., a pregnancy-associated death). This enhanced surveillance has been shown to more comprehensively identify all pregnancy-associated deaths compared with standard surveillance based on death certificate data only.[7] Death certificates, autopsy reports and/or medical records are then reviewed by obstetricians-gynecologists to determine if the death was causally related to the pregnancy or its management (i.e., a pregnancy-related death) or not causally related to the pregnancy or its management.

Key report findings include:

- From 2011 to 2015, there were 273 pregnancy-associated deaths in NYC, of which 115 (42%) were pregnancy-related. This is an increase from 252 pregnancy-associated deaths from 2006 to 2010.
- The pregnancy-related mortality ratio (PRMR) decreased 44% in NYC from 2001 to 2015, from 33.9 deaths per 100,000 live births in 2001 to 18.9 in 2015 ($p<0.002$). Despite this decline, there was no statistically significant change in the PRMR during the most recent period, from 2011 to 2015.
- The PRMR among Black non-Latina women decreased 17% over the past 15 years, from 61.7 per 100,000 live births in 2001-2005 to 51.0 in 2011-2015 ($p<0.011$). The PRMR among Latina women declined by 25% since 2001-2005, from 19.1 per 100,000 live births in 2001-2005 to 14.4 in 2011-2015. The PRMR among Asian/Pacific Islander women and White non-Latina women also decreased since 2001-2005 by 27% and 23%, respectively.
- Black non-Latina women were eight times more likely than White non-Latina women to die from a pregnancy-related cause between 2011 and 2015. The pregnancy-related mortality gap decreased since 2006-2010 when the mortality risk was 12 times greater among Black non-Latina women. However, this should be interpreted with caution as the PRMR among White non-Latina women is based on fewer than 20 deaths and, as a result, may fluctuate more than PRMRs based on higher numbers.
- From 2011 to 2015, the leading causes of pregnancy-related deaths were cardiovascular conditions (25.2%), embolism (21.7%), infection (13.0%) and hemorrhage (12.2%).
- Injury was the leading cause of death among those deaths that were not pregnancy-related (37.8%). Substance use was the leading cause of injury deaths (24 of 59 deaths, 40.7%). Among all substance use deaths from 2011 to 2015, 19 deaths involved an opioid overdose, an increase compared to six opioid overdoses from 2006 to 2010.

This report highlights the critical public health problem of pregnancy-associated mortality in NYC and the unacceptable racial and ethnic inequities that persist. To further reduce maternal mortality in NYC, we must understand and tackle the social inequities and injustices that lead to poor health outcomes, disproportionately affecting people of color.[8-10] Structural racism — or the ways in which societies foster racial and ethnic discrimination by restricting resources, opportunities and support — is a primary contributor to poor health.[11] This includes underinvestment in neighborhoods where people of color live and limited access to high-quality health care and social services, healthy foods, and other resources critical to good health and pregnancy outcomes. Research shows that chronic stressors such as racism, anti-immigrant policies, economic oppression, pregnancy discrimination in the workplace,[12] and poverty can have a severe impact on women's health before, during and after pregnancy,[13,14] including increasing the risk for chronic diseases such as diabetes and high blood pressure, which in turn increase the risk of maternal mortality and other poor outcomes for mothers and infants.[15,16]

The New York City Health Department is committed to reducing maternal mortality by applying an equity framework and sexual and reproductive justice lens in its response to the problem, considering both clinical and social determinants of health. In 2017, the Health Department created a multidisciplinary expert group to review every maternal death in NYC to better understand the clinical and social conditions that lead to the death. The Maternal Mortality and Morbidity Review Committee includes physicians from different specialties as well as midwives, doulas, community representatives, first responders and health system researchers. Participants use their unique perspectives to review every maternal death in NYC, beginning with deaths that occurred in 2016, and then provide actionable recommendations to avoid future deaths at the patient, community, provider, hospital and systems levels.

In 2018, the Health Department launched the Maternity Hospital Quality Improvement Network (MHQIN), a collaboration with 14 public and private NYC Maternity Hospitals that collectively serve approximately one-third of all NYC births, including nearly half of all births to Black and Latina women. The Network is composed of six program components organized across three focal areas: Engage providers in improving the provision of quality care and respectful patient-provider interactions; engage individuals and communities in elevating their power to advocate for quality, respectful and dignified maternal care services; and implement sustainable processes that address the root causes of unequal maternal care and subsequent disparities in maternal and child health outcomes.

▶ **Note:** The authors of this report acknowledge that not every person who gives birth identifies as a woman. Due to limitations in the data on gender identity, the data reflect a person's sex as identified on vital statistics records (i.e., female) and presumes the gender identity "woman" and personal pronouns "she/her/hers." This presumption is a limitation of the report.

Methodology

The Health Department — in close collaboration with OCME — is responsible for ongoing surveillance of pregnancy-associated deaths in NYC. Pallin et al (2002)[7] first described the methodology for pregnancy-associated mortality surveillance in NYC that continues to form the basis for the Health Department's surveillance methods.

Identification of pregnancy-associated deaths

The Health Department uses multiple data sources to identify pregnancy-associated deaths in NYC, including death certificates, vital record linkage, medical examiner records and hospital discharge data. For each case identified, the Health Department requests an electronic copy of the patient's death certificate, along with any corresponding birth or fetal death certificates.

- **Death certificates** are identified for any woman who died in NYC and was pregnant at the time of death or who died within one year of the end of the pregnancy, as identified by the pregnancy checkbox or select underlying causes of death on the certificate (O00-O99, A34).
- **Vital record linkage** uses data from death certificates of women between the ages of 12 and 60 years who died in NYC to determine whether a birth or fetal death certificate was issued to that woman in the year prior to her death.
- **Medical examiner records** are searched using a set of pregnancy-related keywords, to identify any woman who died and was autopsied in NYC and whose medical examiner records had any pregnancy indication within the year prior to her death. The keywords used to search the medical examiner's database include: gesta,* preg,* amnio,* abortion,* ectopic,* placenta,* and partum.*
- **Hospital discharge data** are obtained from the New York State (NYS) Department of Health Statewide Planning and Research Cooperative System (SPARCS), which tracks all inpatient hospital discharges in NYC. Since 2008, the NYS Bureau of Biometrics and Health Statistics (BBHS) has linked SPARCS inpatient hospitalization records to death certificates to determine if the hospitalized person died within 365 days of hospital admission. These linked SPARCS-death files are searched to identify any woman between the ages of 12 and 60 years who had a pregnancy-related hospitalization in NYC and who died within one year from her hospital discharge date. ICD-9-CM and ICD-10-CM codes are used to identify any pregnancy-related hospitalization (see Appendix A). This is the Health Department's first surveillance report that uses linked SPARCS-death file as a data source to identify pregnancy-associated deaths. For previous reports, SPARCS data (without the linked BBHS data) was used to identify any in-hospital deaths during a pregnancy-related hospitalization.

Review of pregnancy-associated deaths

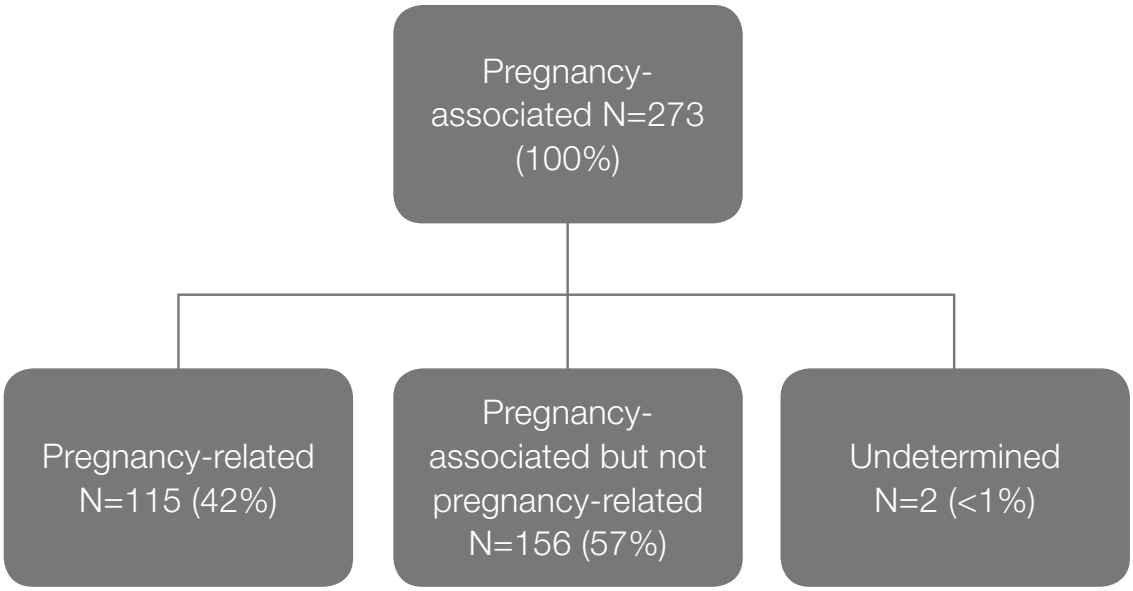
Once the pregnancy-associated deaths are identified from these multiple sources, an OB/GYN at the Health Department reviews all available case records using a data system developed by the Centers for Disease Control and Prevention (CDC).[17] Case records may include death certificates, birth or fetal death certificates, autopsy reports and medical records. This review aims to determine whether the death was pregnancy-related or not and to assign a cause of death based on the CDC's Pregnancy Mortality Surveillance Coding Manual. Demographic data is collected using vital records, including death, birth or fetal death certificates. (see Appendix A).

Definitions

- **Pregnancy-associated death** is the death of a woman from any cause during pregnancy or within one year of the end of the pregnancy. Pregnancy-associated deaths are further categorized based on whether they are causally related to the pregnancy or not.
  - **Pregnancy-related death** is the death of a woman during pregnancy or within one year of the end of the pregnancy due to a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the pregnancy.
  - **Pregnancy-associated but not-related death** is the death of a woman during pregnancy or within one year of the end of the pregnancy due to a cause not related to the pregnancy (e.g., accidents, homicides).
- **Pregnancy-associated mortality ratio (PAMR)** is the annual number of pregnancy-associated deaths per 100,000 live births.
- **Pregnancy-Related Mortality Ratio (PRMR)** is the annual number of pregnancy-related deaths per 100,000 live births. The PRMR is lower than the PAMR because pregnancy-associated but not related deaths are excluded. PRMR is the main indicator reported in the tables and figures of this report. Pregnancy-related mortality ratios based on fewer than 20 deaths are at times presented in this report and should be interpreted with caution.

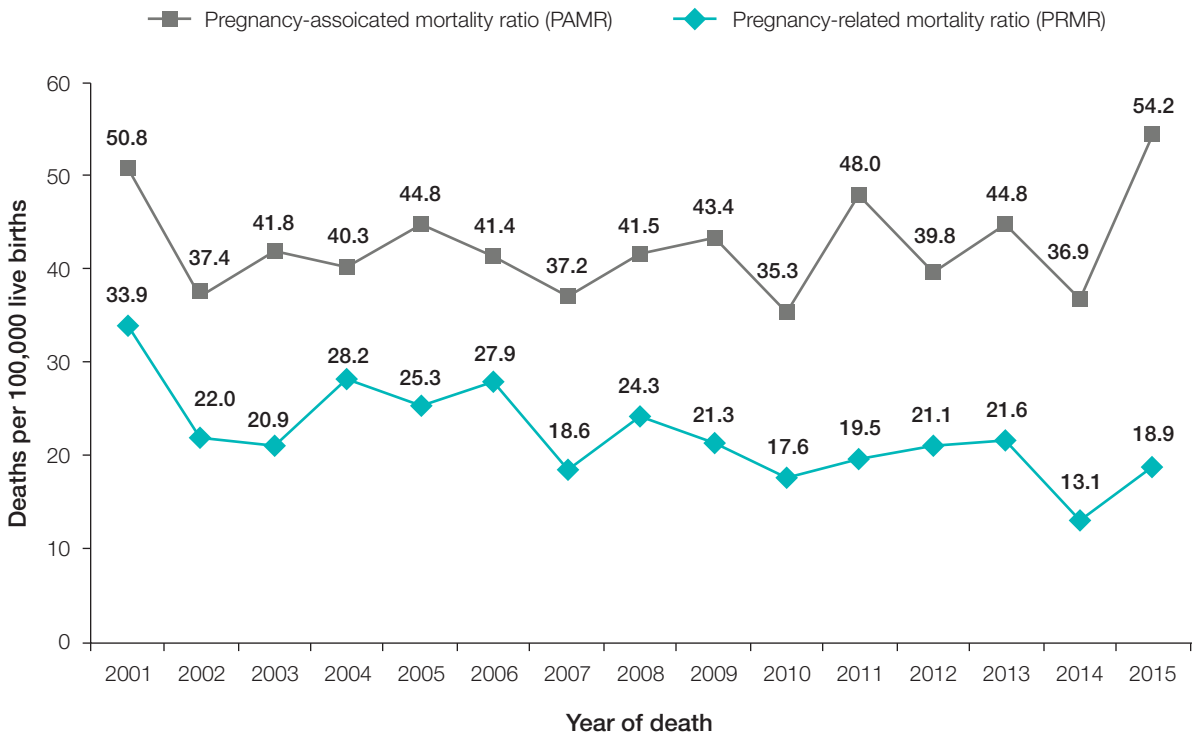
Trends

Figure 1. Classification of pregnancy-associated deaths in New York City, 2011-2015



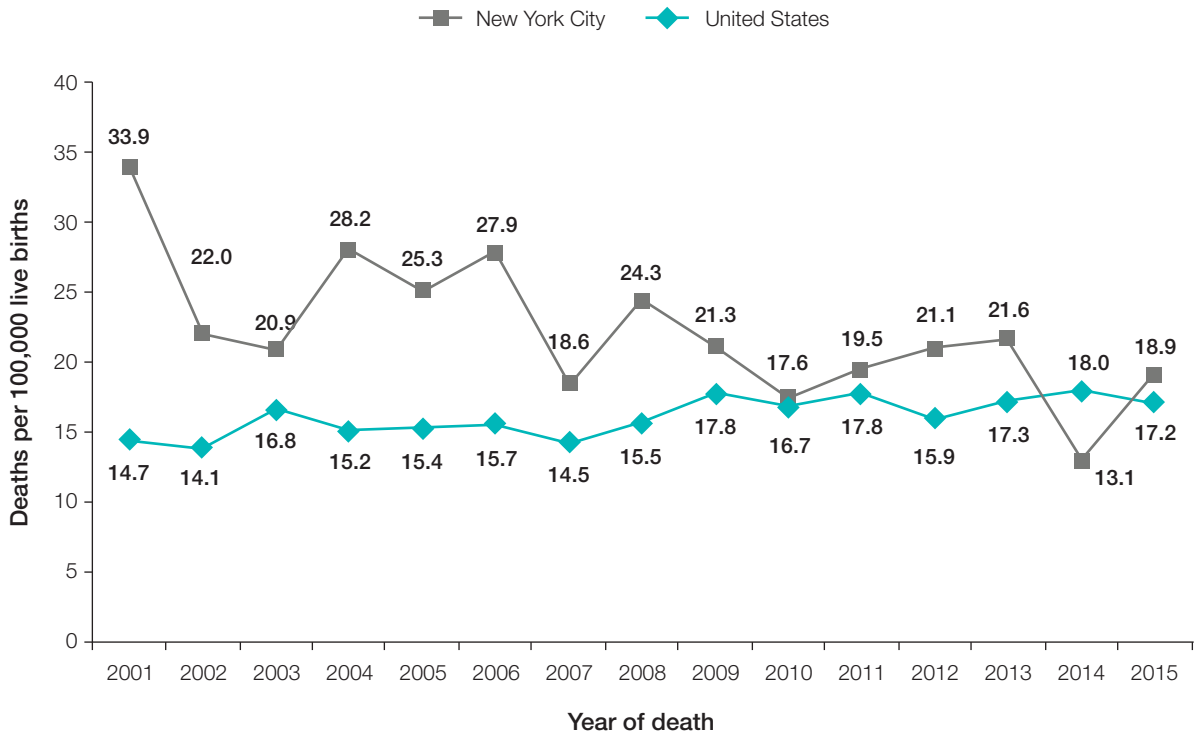
- From 2011 to 2015, there were a total of 273 pregnancy-associated deaths in NYC. Of these deaths, 115 (42%) were pregnancy-related while 156 (57%) were not pregnancy-related. There were two deaths for which the relationship between pregnancy and death could not be determined.

Figure 2. Pregnancy-associated and pregnancy-related mortality ratios, New York City, 2001-2015



- The PRMR in NYC decreased by 44% between 2001 and 2015, from 33.9 deaths per 100,000 live births in 2001 to 18.9 deaths per 100,000 live births in 2015 ($p<0.002$).
- Despite overall improvement in the past 15 years, there was no significant reduction in the PRMR between 2011 and 2015.
- There was no statistically significant change in the PAMR between 2001 (50.8 pregnancy-associated deaths per 100,000 live births) and 2015 (54.2 pregnancy-associated deaths per 100,000 live births).
- We could not determine a specific cause for the decrease in the PAMR and the PRMR during 2014, or the subsequent increase during 2015. These may be random fluctuations in maternal deaths similar to those that have affected the PRMR in previous intervals.

Figure 3. Pregnancy-related mortality ratios, New York City and United States, 2001-2015[18]



Source: *Deaths: Final Data for 2015.* National Vital Statistics Reports. 2017; 66(6).

- Overall, NYC experienced significant reductions in the PRMR since 2001, decreasing 44% from 33.9 in 2001 to 18.9 in 2015. The national PRMR increased 22% from 14.7 deaths per 100,000 live births in 2001 to 17.2 in 2015.
- The PRMR was higher in NYC than in the U.S. for every year between 2001 and 2013. For the first time in 2014, the PRMR in NYC was lower than the national estimate. However, the PRMR in NYC was again higher than in the U.S. in 2015.[3]

Leading Causes of Death

Table 1. Causes of pregnancy-related deaths, New York City, 2011-2015

CAUSE OF DEATH	NUMBER	%
Cardiovascular condition	29	25.2
Cardiomyopathy*	13	—
Other cardiovascular conditions	16	—
Embolism	25	21.7
Infection	15	13.0
Hemorrhage	14	12.2
Pregnancy-induced hypertension	12	10.4
Cancer	5	4.3
Injury	4	3.5
Anesthesia complication	3	2.6
Other	6	5.2
Unknown	2	1.7
Total	**115**	**100.0**

*This report categorized "cardiomyopathy" as "cardiovascular conditions," whereas the previous report categorized "cardiomyopathy" as "other." See Appendix for more information.

- The leading causes of pregnancy-related deaths from 2011 to 2015 were cardiovascular conditions (25.2%), embolism (21.7%), infection (13.0%), hemorrhage (12.2%) and pregnancy-induced hypertension (10.4%).
- The increase in the number pregnancy-related deaths due to cardiovascular conditions was largely driven by an increase in the number of deaths due to cardiomyopathy, which increased from one death from 2006 to 2010 to 13 deaths from 2011 to 2015.
- The proportion of pregnancy-related deaths due to hemorrhage decreased from 2006-2010 (n=38, 27.3%) to 2011-2015 (n=14, 12.2%).
- Nationally, the leading causes of pregnancy-related deaths from 2011-2014 were cardiovascular conditions (excluding cardiomyopathy) (15.2%), non-cardiovascular diseases (14.7%), infection or sepsis (12.8%), hemorrhage (11.5%), cardiomyopathy (10.3%) and thrombotic pulmonary embolism (9.1%).[3]

Table 2. Causes of pregnancy-related deaths by race/ethnicity, New York City, 2011-2015

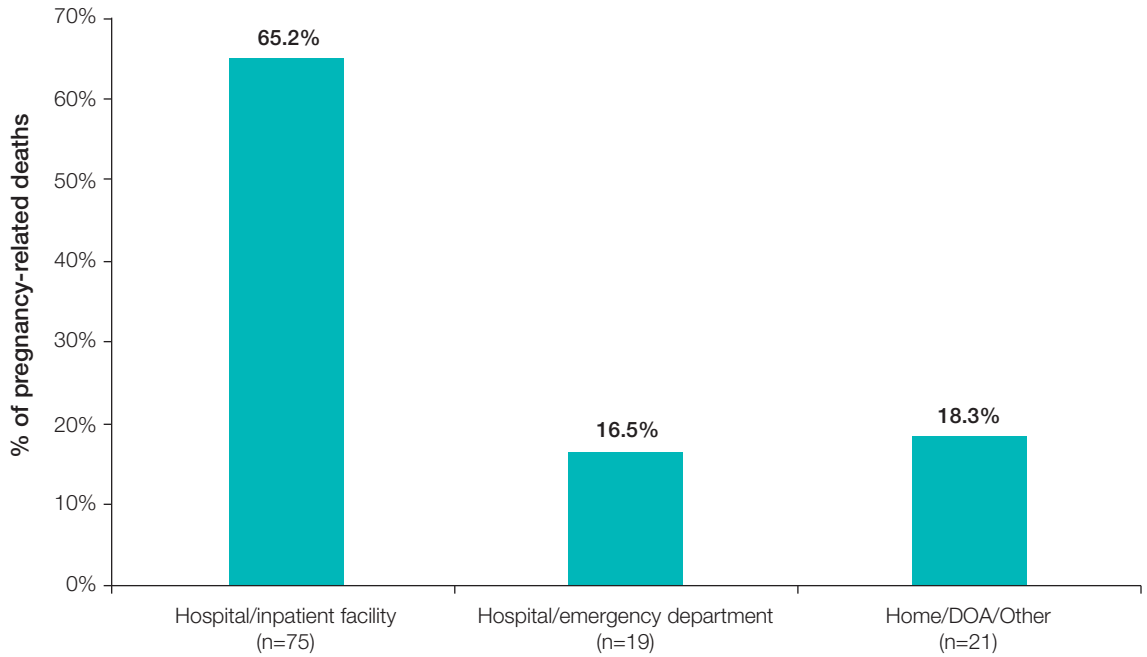
	LATINO/A		BLACK NON-LATINO/A		WHITE NON-LATINO/A		ASIAN/PACIFIC ISLANDER	
Cause of Death	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Cardiovascular condition*	6	23.1	20	31.7	3	23.1	0	0.0
Embolism	4	15.4	17	27.0	1	7.7	3	23.1
Infection	3	11.5	4	6.3	4	30.8	4	30.8
Hemorrhage	6	23.1	6	9.5	0	0.0	2	15.4
Pregnancy-induced hypertension	3	11.5	7	11.1	2	15.4	0	0.0
Cancer	1	3.8	3	4.8	0	0.0	1	7.7
Injury	1	3.8	0	0.0	2	15.4	1	7.7
Anesthesia complication	0	0.0	3	4.8	0	0.0	0	0.0
Other	2	7.7	2	3.2	1	7.7	1	7.7
Unknown	0	0.0	1	1.6	0	0.0	1	7.7
Total	**26**	**100.0**	**63**	**100.0**	**13**	**100.0**	**13**	**100.0**

*This report categorized "cardiomyopathy" as "cardiovascular conditions," whereas the previous report categorized "cardiomyopathy" as "other." See Appendix for more information.

- Pregnancy-related deaths among Black non-Latina women were primarily caused by cardiovascular conditions (n=20, 31.7%), embolism (n=17, 27.0%) and pregnancy-induced hypertension (n=7, 11.1%). The proportion of pregnancy-related deaths due to embolism among Black non-Latina women increased since 2006-2010 (n=16, 20.3%), while pregnancy-inducted hypertension deaths decreased since 2006-2010 (n=12, 15.2%).
- Pregnancy-related hemorrhage deaths accounted for 12.2% (n=14) of all pregnancy-related deaths in NYC from 2011 to 2015. None of these deaths occurred among White non-Latina women.
- Cardiovascular conditions accounted for 25.2% (n=29) of pregnancy-related deaths from 2011 to 2015. None of these deaths occurred among Asian/Pacific Islander women. Similarly, pregnancy-induced hypertension deaths accounted for 10.4% (n=12) of deaths from 2011 to 2015. None of these deaths occurred among Asian/Pacific Islander women.
- Nearly half (n=12, 46.2%) of pregnancy-related deaths among Latina women were caused by cardiovascular conditions or hemorrhage, followed by embolism (n=4, 15.4%).

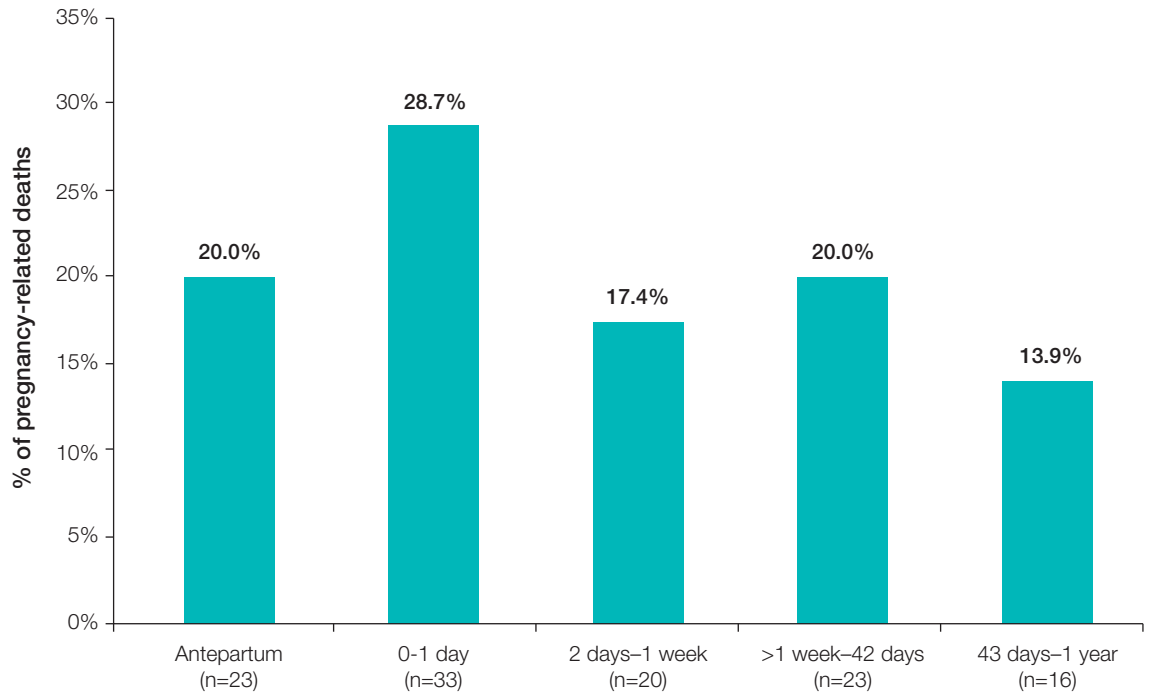
Location and Timing of Death

Figure 4. Percent distribution of pregnancy-related deaths by location of death, New York City, 2011-2015



- The majority (81.7%) of pregnancy-related deaths occurred in the hospital, either in the inpatient facility or in the emergency department, while 18.3% occurred outside the hospital either at home or at another location. This is similar to the findings about location of death from 2006 to 2010.

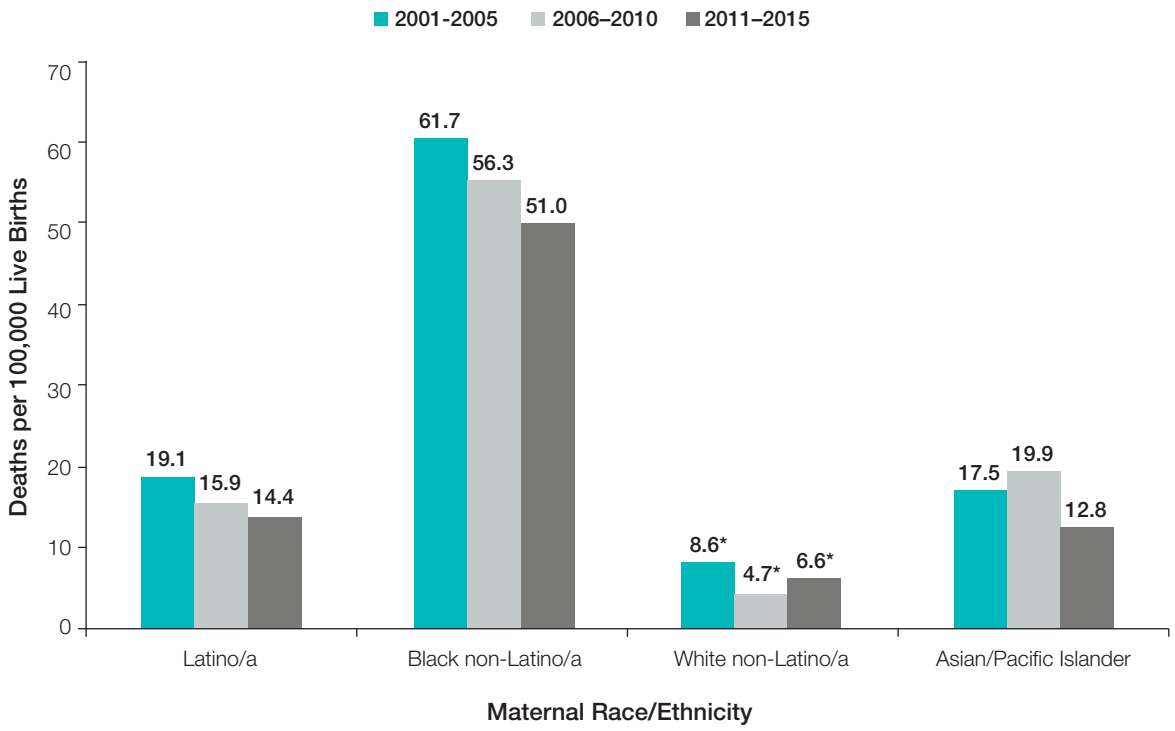
Figure 5. Percent distribution of pregnancy-related deaths by the interval between the end of pregnancy and death, New York City, 2011-2015



- Most pregnancy-related deaths (66.1%) occurred either antepartum or within one week post-pregnancy.
- More than one-quarter (28.7%) of pregnancy-related deaths occurred within one day post-pregnancy.

Demographic Characteristics

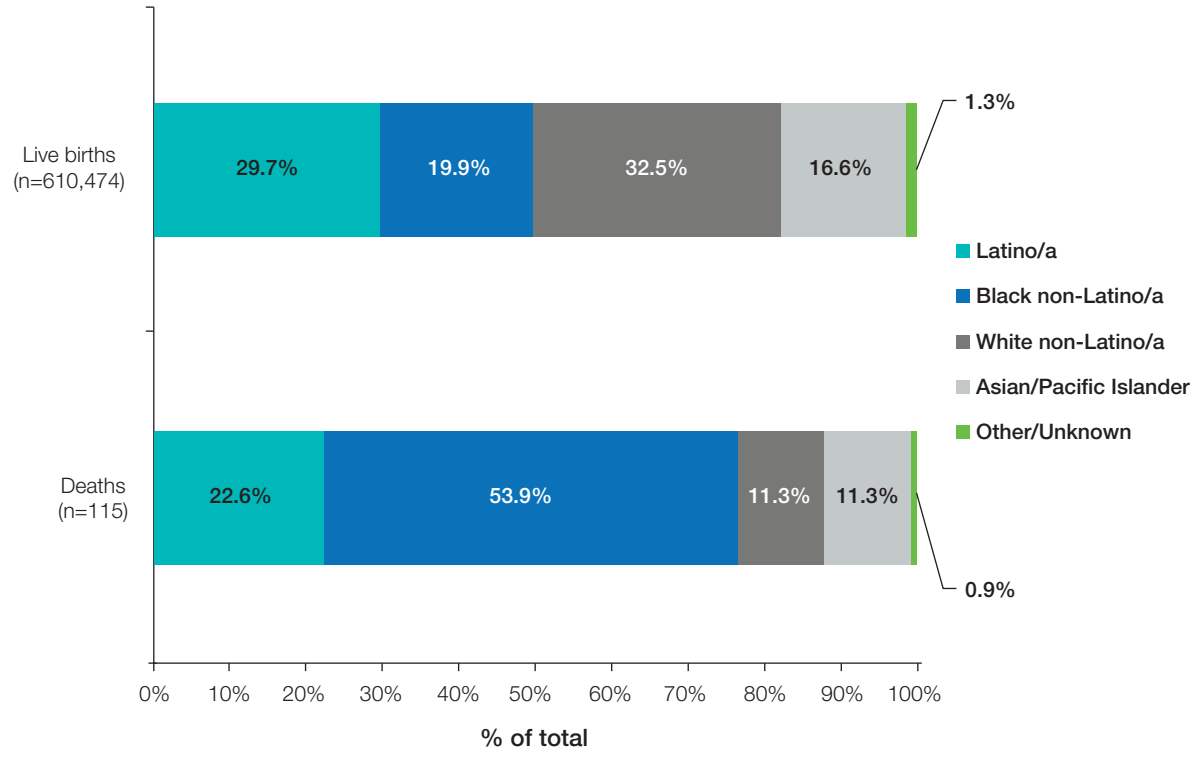
Figure 6. Pregnancy-related mortality ratios by maternal race/ethnicity, New York City, 2001-2015



*PRMR is based on fewer than 20 cases and should be interpreted with caution. See Appendices A and B for more information.

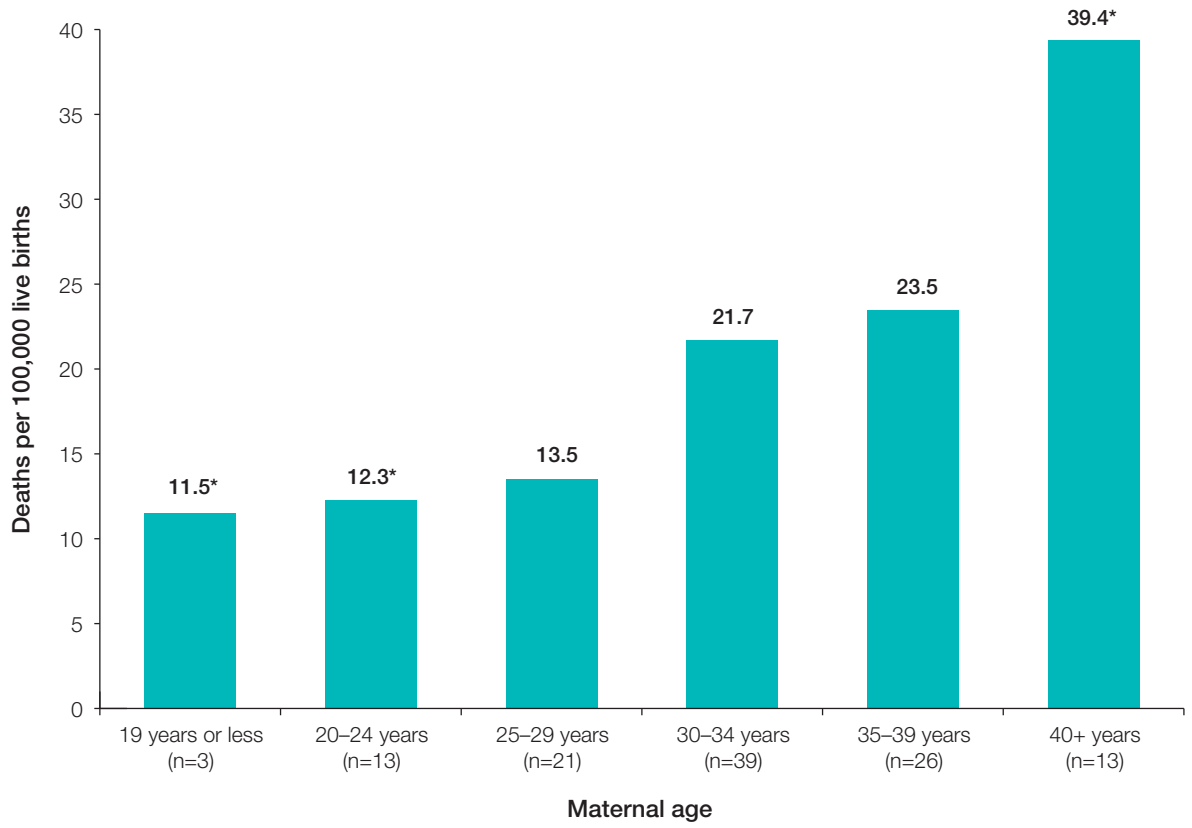
- From 2011 to 2015, Black non-Latina women had the highest PRMR at 51.0 deaths per 100,000 live births followed by Latina women (14.4), Asian/Pacific Islander women (12.8) and White non-Latina women (6.6).
- From 2011 to 2015, the PRMR for Black non-Latina women was eight times higher than that of White non-Latina women. The PRMRs for Latina women and Asian/Pacific Islanders were twice as high as that for White non-Latina women.
- Despite these persistent PRMR disparities, there has been a significant decline in the PRMR among Black non-Latina women in NYC since 2001 ($p<0.011$). This is in contrast to national PRMR trends, which are rising among Black non-Latina women.[3]

Figure 7. Percent distribution of pregnancy-related deaths and live births by race/ethnicity, New York City, 2011-2015



- From 2011 to 2015, Black non-Latina women accounted for a disproportionately higher percentage (53.9%) of pregnancy-related deaths in NYC compared to the percentage of live births in NYC (19.9%). By contrast, White non-Latina women accounted for 32.5% of live births in NYC but only 11.3% of pregnancy-related deaths.

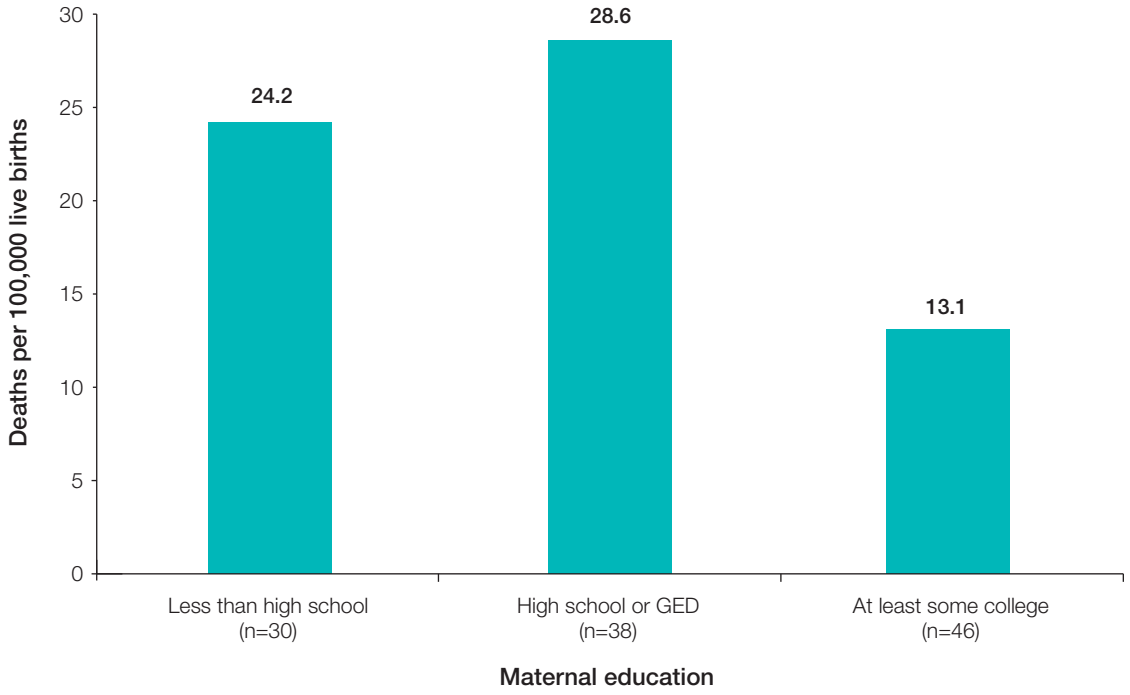
Figure 8. Pregnancy-related mortality ratios by maternal age, New York City, 2011-2015



*PRMR is based on fewer than 20 cases and should be interpreted with caution. See Appendices A and B for more information.

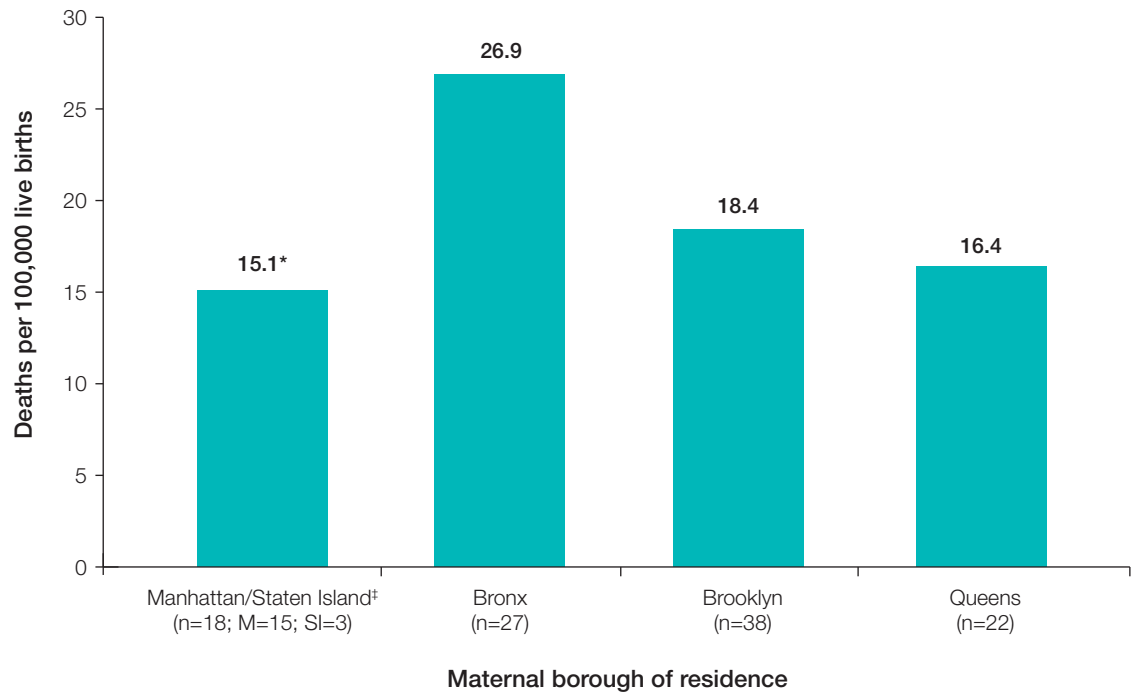
- The PRMR was highest among women ages 40 years and older and lowest among women ages 19 years or younger.

Figure 9. Pregnancy-related mortality ratios by maternal education, New York City, 2011-2015



- From 2011 to 2015, the PRMR was significantly lower among women with at least some college education (13.1 deaths per 100,000 live births) compared to those who had a high school or GED degree (28.6 deaths per 100,000 live births). Among women with some college, the PRMR was slightly lower compared to women who did not graduate high school (24.2 deaths per 100,000 live births).

Figure 10. Pregnancy-related mortality ratios by maternal borough of residence, New York City, 2011-2015

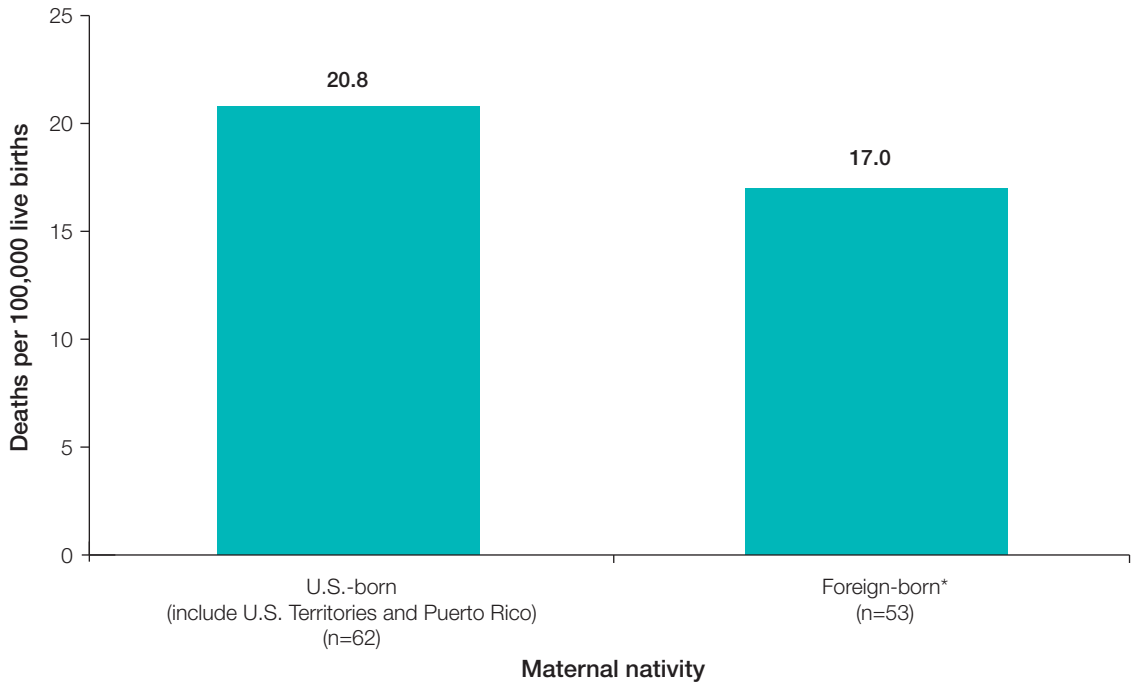


*PRMR is based on fewer than 20 cases and should be interpreted with caution. See Appendices A and B for more information.

‡Manhattan and Staten Island were combined given the small number of pregnancy-related deaths among women who lived in those boroughs prior to their deaths.

- The Bronx had the highest PRMR (26.9 deaths per 100,000 live births), followed by Brooklyn (18.4), Queens (16.4) and Manhattan/Staten Island (15.1). However, there was no statistically significant difference in PRMRs across different boroughs of residence (see Appendix A and B for more information).

Figure 11. Pregnancy-related mortality ratios by maternal nativity, New York City, 2011-2015

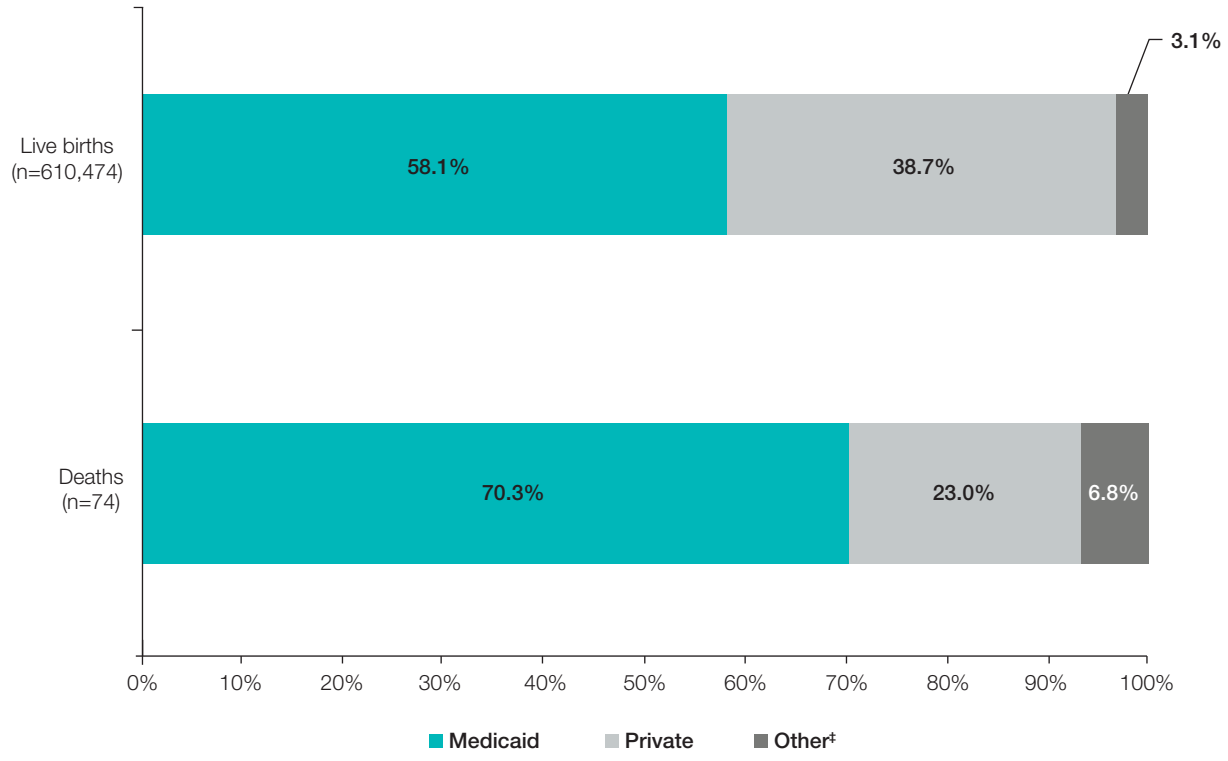


*Small number of deaths per foreign-born country limits the ability to analyze PRMR by country.

- From 2011 to 2015, the PRMRs for U.S.-born and foreign-born women were statistically similar at 20.8 and 17.0 deaths per 100,000 live births, respectively.
- There was no statistical difference in PRMR by nativity status for Latina women or Black non-Latina women from 2011 to 2015. (Data not shown)

Prenatal and Clinical Characteristics

Figure 12. Percent distribution of pregnancy-related deaths and live births by insurance type,* New York City, 2011-2015



*Seventy-four of the 115 pregnancy-related deaths in 2011-2015 had a corresponding birth certificate issued to the decedent in the year prior to death, which recorded her insurance type.
‡Includes other government type, self-pay and unknown.

- From 2011 to 2015, the majority (70.3%) of pregnancy-related deaths with a live birth outcome were listed as having Medicaid coverage. During the same time period, 58.1% of all live births were listed as having Medicaid coverage.

Table 3. Distribution of pregnancy outcomes among pregnancy-related deaths, New York City, 2011-2015

PREGNANCY OUTCOME	NUMBER	%
Live birth	74	64.3
Undelivered	15	13.0
Spontaneous termination of pregnancy	10	8.7
Molar/trophoblastic pregnancy	5	4.3
Stillborn (>20 weeks gestation)	5	4.3
Induced termination of pregnancy	4	3.5
Ectopic pregnancy	2	1.7
Total	**115**	**100.0**

- The most common pregnancy outcome among pregnancy-related deaths was a live birth (n=74, 64.3%) followed by undelivered (n=15, 13.0%) and spontaneous termination of pregnancy (n=10, 8.7%).
- The proportion of ectopic-pregnancy outcomes among pregnancy-related deaths decreased from 10.8% in 2006-2010 to 1.7% in 2011-2015.

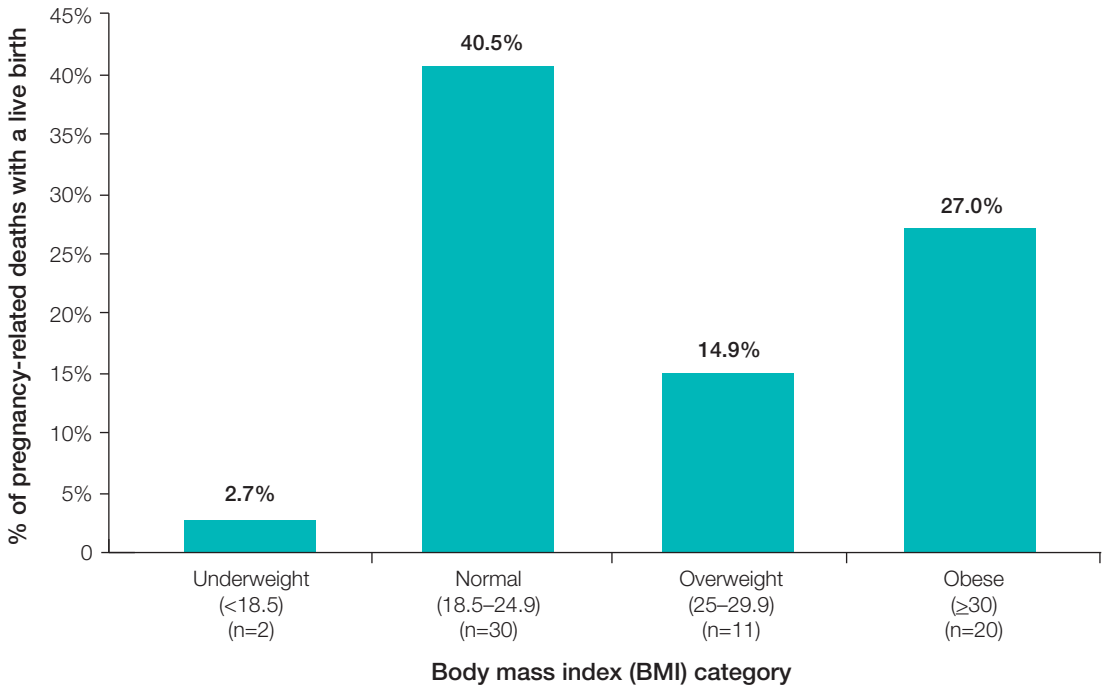
Table 4. Percent distribution of pregnancy-related deaths that resulted in a live birth,* by number of previous live births, New York City, 2011-2015

NUMBER OF PREVIOUS LIVE BIRTHS	NUMBER	%
None	31	41.9
1	19	25.7
2	7	9.5
3 or more	13	17.6
Unknown	4	5.4
Total	**74**	**100.0**

*Seventy-four of the 115 pregnancy-related deaths in 2011-2015 had a corresponding birth certificate issued to the decedent in the year prior to death, which recorded the number of her previous live births.

- Among pregnancy-related deaths that resulted in a live birth, 41.9% had no previous live birth, 25.7% had one previous live birth, 9.5% had two and 17.6% had three or more previous live births.

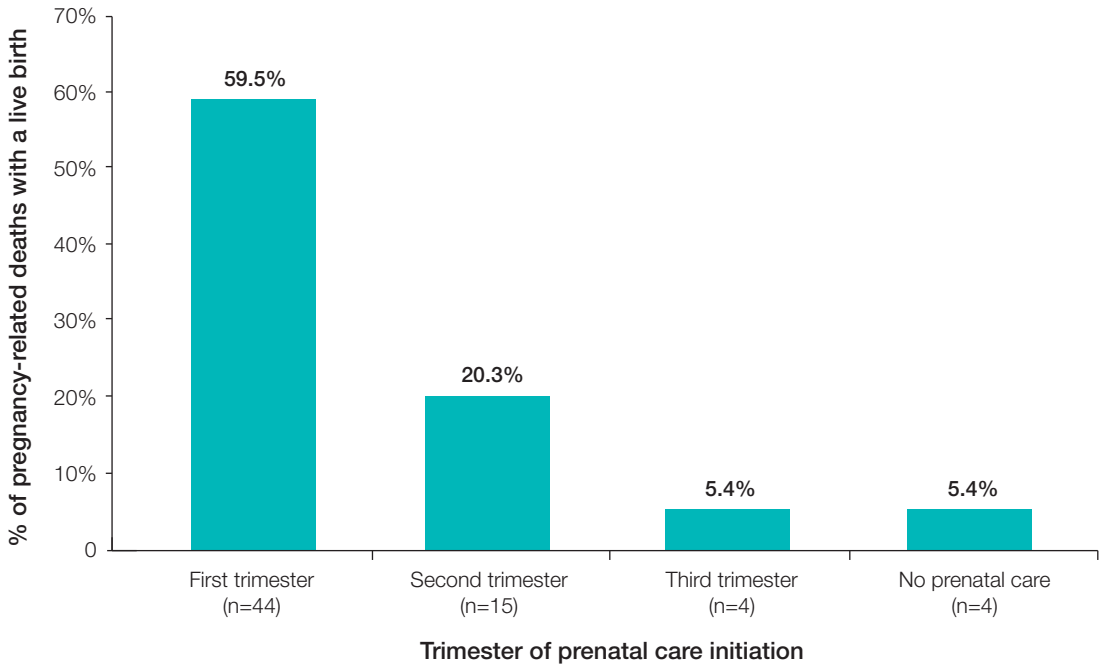
Figure 13. Percent distribution of pregnancy-related deaths resulting in a live birth,* by pre-pregnancy body mass index (BMI) categories, New York City, 2011-2015



*Seventy-four of the 115 pregnancy-related deaths in 2011-2015 had a corresponding birth certificate issued to the decedent in the year prior to death, which recorded her pre-pregnancy height and weight.

- Among pregnancy-related deaths that resulted in a live birth, 40.5% had a normal pre-pregnancy BMI (i.e., a BMI between 18.5 and 24.9), and 41.9% had an overweight or obese pre-pregnancy BMI (i.e., a BMI higher than 25).

Figure 14. Percent distribution of pregnancy-related deaths resulting in a live birth,* by trimester of prenatal care initiation, New York City, 2011-2015



*Seventy-four of the 115 pregnancy-related deaths in 2011-2015 had a corresponding birth certificate issued to the decedent in the year prior to death, which recorded her prenatal care initiation trimester.

- Among pregnancy-related deaths that resulted in a live birth, 59.5% had initiated prenatal care within the first trimester and 79.8% had initiated prenatal care by the end of the second trimester. Only 5.4% of women who died (four women) received no prenatal care.

Causes of Death for Pregnancy-Associated but Not Pregnancy-Related Deaths

Table 5. Causes of death when *not* pregnancy-related, New York City, 2011-2015

CAUSE OF DEATH	NUMBER	%
Injury	59	37.8
Cancer	36	23.1
Cardiovascular condition	13	8.3
Neurologic/neurovascular problem	11	7.1
Pulmonary Problem	7	4.5
Infection*	6	3.8
Gastrointestinal disorders	6	3.8
Hematopoietic problem (e.g., sickle cell disease)	3	1.9
Thrombotic (includes pulmonary embolism)	2	1.3
Intracerebral hemorrhage	2	1.3
Cardiac arrhythmia	1	0.6
Collagen vascular disease	1	0.6
Metabolic problem, not pregnancy-related	1	0.6
Other conditions not specified above	6	3.8
Unknown	2	1.3
Total	**156**	**100.0**

*Includes CDC codes 22 and 28. For more information, see Appendix A.

- Among deaths not related to pregnancy, the most common cause was injury (n=59, 37.8%) followed by cancer (n=36, 23.1%) and cardiovascular condition (n=13, 8.3%).

Table 6. Types of injuries causing death when *not* pregnancy-related, New York City, 2011-2015

TYPE OF INJURY	NUMBER	%
Substance use*	24	40.7
Opioid substance	19	—
Homicide	14	23.7
Motor vehicle accident‡	11	18.6
Suicide	9	15.3
Other	1	1.7
Total	**59**	**100.0**

*Includes chronic substance use.
‡Includes accidents involving an automobile, train or pedestrian strike.

- Among fatal injuries not related to pregnancy, the most common cause was substance use (n=24, 40.7%) followed by homicide (n=14, 23.7%) and motor vehicle accidents (n=11, 18.6%).
- Among all substance use deaths, 19 deaths involved an opioid substance. That is three times the number of deaths that involved an opioid substance in 2006-2010 (six deaths).

Table 7. Types of cancers causing death when *not* pregnancy-related, New York City, 2011-2015

TYPE OF INJURY	NUMBER	%
Brain and other nervous system	6	16.7
Colon and rectum	6	16.7
Leukemia	5	13.9
Non-Hodgkin lymphoma	4	11.1
Liver and intrahepatic bile duct	3	8.3
Pancreas	2	5.6
Stomach	2	5.6
Breast	2	5.6
Cervix uteri	2	5.6
Kidney and renal pelvis	1	2.8
Ovary	1	2.8
Other*	2	5.6
Total	**36**	**100.0**

*Includes sarcomas.

- Among deaths not related to pregnancy, the leading cancer causes were brain and other nervous system cancers (16.7%) and colon and rectum cancers (16.7%).

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Appendix A. Methodology Notes

ICD-9-CM and ICD-10-CM codes for pregnancy indications during hospitalization

BMIRH uses multiple data sources to identify pregnancy-associated deaths in NYC, including death certificates, vital record linkages, medical examiner reports and inpatient hospital discharge data as described in the "Methodology" section on Page 7.

For inpatient hospital discharge data linked to death certificates, this report uses the following wide-ranging International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) for January 1, 2011, to September 30, 2015, and International Classification of Diseases, 10th Revision, Clinical Modification and Procedure Coding System (ICD-10-CM/PCS) for October 1, 2015, to December 31, 2015, codes to search for any potential indication of pregnancy during an inpatient hospitalization in the year prior to the woman's death.

CLASSIFICATION	DESCRIPTION	CODE
	ICD-9-CM	
Diagnosis codes	Malignant neoplasm of placenta	181
	Neoplasm of uncertain behavior of placenta	236.1
	Pica	307.52
	Incompetence of cervix	622.5
	Complications of pregnancy, childbirth and the puerperium	630-677
	Non-specific abnormal findings in amniotic fluid	792.3
	Vaccine for rubella	V04.3
	Supervision of normal pregnancy	V22.x
	Supervision of high-risk pregnancy	V23.xx
	Postpartum care and examination	V24.xx
	Menstrual extraction	V25.3
	Outcome of delivery	V27.x
	Antenatal screening	V28.xx
	Multi-parity	V61.5
	Illegitimate pregnancy	V61.6
	Other unwanted pregnancy	V61.7
	Pregnancy examination or test — positive result	V72.42
Procedure codes	Salpingectomy with removal of tubal pregnancy	66.62
	Suture of laceration of cervix	67.61
	Dilation and curettage for pregnancy termination	69.01
	Dilation and curettage following delivery or abortion	69.02
	Aspiration curettage of uterus for pregnancy termination	69.51

CLASSIFICATION	DESCRIPTION	CODE
Procedure codes *(continued)*	Aspiration curettage following delivery or abortion	69.52
	Menstrual extraction	69.6
	Insertion of laminaria	69.93
	Manual replacement of inverted uterus	69.94
	Removal of cerclage material from cervix	69.96
	Operations on vulva and perineum	71.7x
	Other operations on vulva	71.8
	Other operations on female genital organs	71.9
	Obstetrical procedures	72.xx-75.xx
	X-ray of gravid uterus	87.81
	Placental scan	92.17
	Prenatal training	93.37
	Milk extraction	99.98
Diagnosis Related Group (DRG) codes	Pregnancy, childbirth and puerperium	765-770 and 774-782
	ICD-10-CM	
Diagnosis codes	Pregnancy, childbirth and puerperium	O00.xx-O99.xx, O9A.xx
	Menstrual extraction	Z30.3
	Encounter for procreative management	Z31.xxx
	Encounter for pregnancy test and childbirth and child-care instruction	Z32.xx
	Pregnant state	Z33.x
	Encounter for supervision of normal pregnancy	Z34.xx
	Encounter for supervision of high-risk pregnancy	Z35.xx
	Encounter for antenatal screening of mother	Z36.xx
	Outcome of delivery	Z37.xx
	Live born infants according to place of birth and type of delivery	Z38.xx
	Encounter for maternal postpartum care and examination	Z39.x
	Weeks of gestation	Z3A.xx
	Problems related to unwanted pregnancy	Z64.0
	Problems related to multi-parity	Z64.1
	Malignant neoplasm of placenta	C58
	Neoplasm of uncertain behavior of placenta	D39.2
	Incompetence of cervix uteri	N88.3
	Obstetrical tetanus	A34

Cause of death codes and categorizations

CDC CATEGORY	CDC CODE	CAUSE OF DEATH DESCRIPTION
Hemorrhage	1	Uterine laceration or rupture
	2	Abruptio placentae
	3	Placenta previa
	4	Rupture ectopic pregnancy
	5	Uterine atony, postpartum bleeding or not otherwise specified (NOS)
	6	Uterine bleeding or NOS
	7	Retained placenta or products of conception
	8	Coagulopathies (including disseminated intravascular coagulation)
	10	Placenta accreta, percreta or increta
	18	Other (uterine artery laceration, intra-abdominal and other sites of hemorrhage)
	19	Unknown
Infection	20	Chorioamnionitis or antepartum infection
	21	Postpartum pelvic infection
	22	Generalized septicemia, septic shock or septic abortion
	23	Peritonitis
	24	Other pelvic tract infection
	25	Nonpelvic infection (e.g., pneumonia)
	26	Urinary tract infections (e.g., pyelonephritis, cystitis, urinary tract infection)
	28	Other
	29	Unknown/NOS
Embolism	30	Thrombotic (includes pulmonary embolism, NOS)
	31	Amniotic fluid, documented by autopsy or Swan Ganz catheterization
	32	Amniotic fluid, not documented by autopsy
	33	Amniotic fluid, NOS
	34	Cardiac embolism
	35	Air
	38	Other (includes septic embolism)
	39	Unknown/NOS pulmonary embolism
Pregnancy-induced hypertension	40	Cerebrovascular hemorrhage
	41	Cerebral edema
	42	Cerebral embolism
	43	Metabolic complications (renal and/or hepatic failure)
	44	Hemolysis, elevated liver enzymes, low platelet count (HELLP syndrome)
	45	Disseminated Intravascular Coagulation

CDC CATEGORY	CDC CODE	CAUSE OF DEATH DESCRIPTION
Pregnancy-induced hypertension *(continued)*	48	Other (includes encephalopathy)
	49	Unknown/NOS
	50	Cerebrovascular hemorrhage
	51	Cerebral edema
	52	Cerebral embolism
	53	Metabolic complications (renal and/or hepatic failure)
	54	HELLP syndrome
	55	Disseminated Intravascular Coagulation
	58	Other (includes encephalopathy)
	59	Unknown/NOS
	60	Cerebrovascular hemorrhage
	61	Cerebral edema
	62	Cerebral embolism
	63	Metabolic complications (renal and/or hepatic failure)
	64	HELLP syndrome
	68	Other (includes encephalopathy)
	69	Unknown/NOS
Anesthesia complications	70	Aspiration
	71	Inadvertent over-dosage of anesthesia/analgesia
	72	Induction or intubation problems (includes esophageal intubation)
	73	Drug reaction or anaphylaxis
	74	High spinal or epidural
	75	Inadequate ventilation, NOS
	76	Local or regional anesthesia toxicity (includes unintentional intravascular injection)
	77	Respiratory failure during or after anesthesia, NOS
	78	Other
	79	Unknown/NOS
Cardiovascular conditions	80	Cardiomyopathy
	81	Cardiac arrhythmia
	84	Cardiac arrest/failure, NOS
	90	Cardiovascular problems
Injury	88	Injury (intentional or non-intentional)
Cancer	89	Cancer (benign or malignant tumor or disease), includes genital tract neoplasm
Other cause of death	82	Hematopoietic (sickle cell, thalassemia, immune thrombocytopenic purpura)
	83	Collagen vascular diseases

CDC CATEGORY	CDC CODE	CAUSE OF DEATH DESCRIPTION
Other cause of death *(continued)*	85	Metabolic, pregnancy-related (includes gestational diabetes, liver disease of pregnancy, etc.)
	86	Metabolic, not pregnancy-related (includes diabetes mellitus)
	87	Immune deficiency problems (includes HIV infection/AIDS)
	91	Pulmonary problems
	92	Neurologic or neurovascular problems
	93	Renal failure
	94	Multiple organ or system failure, NOS
	95	Intracerebral hemorrhage (not associated with pregnancy-induced hypertension)
	97	Gastrointestinal disorders
	98	Other conditions not specified above
Unknown	99	Unknown

Demographic and clinical variables

- **Cause of death** is based on the underlying cause of death as listed on the death certificate and coded using the CDC pregnancy mortality surveillance coding manual. Throughout this report, cause of death codes were further grouped according to the above listed categorizations.
- **Location of death** is based on the location where the death occurred as listed on the death certificate.
- **Interval between the end of pregnancy and death** was tabulated based on the number of days from the date of death as listed on the death certificate to the date of birth or fetal death as listed on the birth or fetal death certificate. If there was no corresponding birth or fetal death certificate, the date of outcome listed on the death certificate was used, or the interval from pregnancy outcome to death was derived from medical or autopsy records.
- **Maternal age** is based on the age at the time of death as listed on the death certificate.
- **Maternal race/ethnicity** is primarily derived from self-reported race/ethnicity of mother as listed on the birth or fetal death certificate. If there was no corresponding birth or fetal death certificate, or the data were missing, information listed on the death certificate was used to fill the missing value.

- **Maternal education** is based on the total years of education completed at the time of death as self-reported on the birth or fetal death certificate. If there was no corresponding birth or fetal death certificate, or the data were missing, information recorded on the death certificate was used to fill the missing value.
- **Maternal borough of residence** is based on the borough of residence at the time of death as listed on the death certificate. If this information was missing, the borough of residence listed on the birth or fetal death certificate was used to fill the missing value.
- **Maternal nativity** is primarily derived from data recorded on the birth or fetal death certificate. If there is no corresponding birth or fetal death certificate for the maternal death, or the data were missing, information recorded on the death certificate was used to fill the missing value.
- **Insurance type** is available for maternal deaths where the pregnancy outcome was a live birth and is derived from information recorded on the birth certificate.
- **Pregnancy outcome** is primarily derived from the presence of a birth or fetal death certificate corresponding to the maternal death and, if not available, from the pregnancy outcome listed on the death certificate. In some cases, further review of medical or autopsy records was needed to obtain this information.
- **Live birth order** is available for maternal deaths where the pregnancy outcome was a live birth and is derived from information recorded on the birth certificate.
- **Pre-pregnancy BMI** is available for maternal deaths where the pregnancy outcome was a live birth and is derived from information recorded on the birth certificate.
- **Prenatal care initiation** is available for maternal deaths where the pregnancy outcome was a live birth and is derived from information recorded on the birth certificate.

Data analysis

Pregnancy-related mortality ratios (PRMR) are presented as the number of pregnancy-related deaths per 100,000 live births that occurred during a calendar year. Confidence intervals for PRMRs were tabulated using a derivation of the gamma method, given the small number of deaths. See Appendix B for the 95% confidence intervals. The difference between two ratios is statistically significant if the confidence intervals do not overlap across groups or levels. For significance testing of trends over time in PRMR, BMIRH used a simple linear regression model for significance testing based on the confidence intervals of the slope estimate.

Data limitations

Ratios based on small counts

Pregnancy-associated deaths are rare events. The Health Department does not routinely publish or release rates based on fewer than 20 observations due to of the limited reliability of estimates from small numbers. However, pregnancy-related mortality ratios based on fewer than 20 deaths are at times presented in this report and should be interpreted with caution. See Appendix B for the 95% confidence intervals for all reported pregnancy-related mortality ratios.

Missing data

Some records were not complete and were missing demographic or other information. Cases with missing data were recorded as "unknown/not reported" and were not included in the presentation of the data for that variable.

Methodological updates since previous reports

Pregnancy-associated deaths for this surveillance report were also found by searching hospital discharge records linked to death certificates. These records were not available for identifying deaths in previous reports. By searching this new data source, 10 additional pregnancy-associated deaths were found during the reporting period. This may lead to a higher reported number of deaths, especially pregnancy-associated but not related deaths.

Cardiomyopathy as a cause of death was categorized among "other" causes of death in the "Pregnancy-Associated Mortality in New York City, 2006-2010" report, and was categorized among "cardiovascular conditions" for this report.

Choriocarcinoma (i.e., any malignancy arising from placental tissue) as a cause of death is always related to a past pregnancy. To meet the criteria to be categorized as a pregnancy-associated or related death, BMIRH requires accurate knowledge of the end date of the last pregnancy before a woman died. However, obtaining clear documentation of the end date of the last pregnancy prior to death for a woman dying from choriocarcinoma can be extremely challenging. In this report, we categorized all such cases as "pregnancy-related" even if there was unclear documentation for the end of the last pregnancy.

Appendix B. Supplemental Data Tables

Table B1. Number of live births, classification of pregnancy-associated deaths and mortality ratios with 95% confidence intervals (CI), New York City, 2011-2015

	LIVE BIRTHS	PREGNANCY-ASSOCIATED DEATHS	PREGNANCY-ASSOCIATED MORTALITY RATIO (95% CI)	PREGNANCY-RELATED DEATHS	PREGNANCY-RELATED MORTALITY RATIO (95% CI)	NOT PREGNANCY-RELATED DEATHS	UNDETER-MINED
2011	123,029	59	48.0 (36.5, 61.9)	24	19.5 (12.5, 29.0)	35	0
2012	123,231	49	39.8 (29.4, 52.6)	26	21.1 (13.8, 30.9)	22	1
2013	120,457	54	44.8 (33.7, 58.5)	26	21.6 (14.1, 31.6)	28	0
2014	122,084	45	36.9 (26.9, 49.3)	16	13.1 (7.5, 21.3)	29	0
2015	121,673	66	54.2 (41.9, 69.0)	23	18.9 (12.0, 28.4)	42	1
Total	**610,474**	**273**	**44.7**	**115**	**18.8**	**156**	**2**

Table B2. Demographic characteristics of pregnancy-related deaths, New York City, 2011-2015

	LIVE BIRTHS		PREGNANCY-RELATED DEATHS		PRMR (95% CI)
	Number	%	Number	%	
Maternal age					
≤19	25,975	4.3	3	2.6	11.5 (6.6, 18.8)
20-24	105,893	17.3	13	11.3	12.3 (7.0, 19.9)
25-29	155,358	25.4	21	18.3	13.5 (8.4, 20.7)
30-34	179,492	29.4	39	33.9	21.7 (15.4, 29.7)
35-39	110,775	18.1	26	22.6	23.5 (15.3, 34.4)
40+	32,981	5.4	13	11.3	39.4 (21.0, 67.4)
Race/ethnicity					
Latino/a	181,059	29.7	26	22.6	14.4 (9.4, 21.0)
Black non-Latino/a	121,487	19.9	62	53.9	51.0 (39.1, 65.4)
White non-Latino/a	198,308	32.5	13	11.3	6.6 (3.5, 11.2)
Asian/Pacific Islander	101,596	16.6	13	11.3	12.8 (6.8, 21.9)
Non-Latino/a of 2+ races	5,452	0.9	0	0.0	—
Other/unknown	2,572	0.4	1	0.9	—
Education					
Less than high school	124,004	20.3	30	26.1	24.2 (16.3, 34.5)
High school or GED	132,910	21.8	38	33.0	28.6 (20.2, 39.3)
At least some college	351,599	57.6	46	40.0	13.1 (9.6, 17.5)
Unknown	1,961	0.3	1	0.9	
Borough of residence					
Manhattan	92,519	15.2	15	13.0	16.2 (9.1, 26.7)
Bronx	100,364	16.4	27	23.5	26.9 (17.7, 39.1)
Brooklyn	206,195	33.8	38	33.0	18.4 (13.0, 25.3)
Queens	134,183	22.0	22	19.1	16.4 (10.3, 24.8)
Staten Island	26,564	4.4	3	2.6	11.3 (2.3, 33.0)
Non-NYC resident	50,601	8.3	10	8.7	19.8 (9.5, 36.3)
Unknown	48	0.0	0	0.0	—
Nativity					
U.S.-born	298,517	48.9	62	53.9	20.8 (15.9, 26.6)
Foreign-born	311,814	51.1	53	46.1	17.0 (12.7, 22.2)
Unknown	143	0.0	0	0.0	—

Table B3. Location, timing and prenatal and clinical characteristics of pregnancy-related deaths, New York City, 2011-2015

	NUMBER	%
Location of death		
Hospital-inpatient	75	65.2
Hospital-emergency department	19	16.5
Home/DOA/Other	21	18.3
Pregnancy interval		
Antepartum	23	20.0
0-1 day	33	28.7
2 days-1 week	20	17.4
>1 week-42 days	23	20.0
43 days-1 year	16	13.9
Insurance type‡		
Medicaid	52	70.3
Private	17	23.0
Other*	5	6.8
Pre-pregnancy BMI categories‡		
Underweight (<18.5)	2	2.7
Normal weight (18.5-24.9)	30	40.5
Overweight (25.0-29.9)	11	14.9
Obese class I (30.0-34.9)	6	8.1
Obese class 2 (35.0-39.9)	7	9.5
Obese class 3 (≥40.0)	7	9.5
Unknown	11	14.9
Trimester of prenatal care initiation‡		
First trimester	44	59.5
Second trimester	15	20.3
Third trimester	4	5.4
No prenatal care	4	5.4
Unknown	7	9.5

*Includes other government type, self-pay and unknown.
‡Among pregnancy-related deaths resulting in a live birth.

Notes

Notes


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