Pregnancy-Associated Mortality

New York City, 2006-2010

NYC Health

New York City Department of Health and Mental Hygiene
Bureau of Maternal, Infant and Reproductive Health

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Executive Summary

The dramatic decline in maternal mortality in the United States is one of the great public health successes of the 20th century. However, recent national data suggest that maternal mortality is increasing, and Black, non-Hispanic women continue to have an elevated risk of death compared to White, non-Hispanic women.[1]

This report provides estimates and examines characteristics and causes of death within one year of pregnancy in New York City. Although we present data on *pregnancy-associated deaths* (deaths during pregnancy or within one year of pregnancy from any cause), the focus of the report is on *pregnancy-related deaths*, a subset of pregnancy-associated deaths that are causally related to pregnancy. For the purpose of this report, we refer to pregnancy-related deaths interchangeably as maternal deaths and maternal mortality. The findings are based on enhanced surveillance of pregnancy-associated deaths that occurred in New York City between 2006 and 2010 conducted by the New York City Department of Health and Mental Hygiene's Bureau of Maternal, Infant and Reproductive Health. Enhanced surveillance involves the use of multiple data sources to identify and review deaths that occur during pregnancy or within one year from the end of pregnancy. This differs from standard surveillance, which relies only on death certificate data to identify and categorize deaths, and reports only on deaths that occur during pregnancy or within 42 days of pregnancy.

Numerous studies have found that enhanced surveillance improves case ascertainment of deaths that are temporally associated with pregnancy, and allows for a more complete understanding of the causes and characteristics of deaths.[2,3] The Health Department's enhanced surveillance protocol was informed by guidelines from the American Congress of Obstetricians and Gynecologists and the Centers for Disease Control and Prevention Maternal Mortality Study Group.[4] From 2006 to 2010, cases were identified using three data sources: death certificates, medical examiner records and hospital discharge data. Information from all three data sources, along with linked birth certificate information and hospital medical records, were reviewed by an obstetrician/gynecologist, who determined cause of death and whether the death was causally or only temporally related to pregnancy. More information on this methodology is available at: nyc.gov/html/doh/downloads/pdf/ms/ms-report-online.pdf.[5]

Pregnancy-associated deaths are categorized as either pregnancy-related (causally related to pregnancy) or not pregnancy-related (not causally related). Pregnancy-related mortality ratios are calculated by the following characteristics: maternal age, race/ethnicity, education, nativity and borough of residence. Place of death, interval between the end of pregnancy and death, pregnancy outcome, pregnancy history and cause of death are also reported.

The pregnancy-related mortality ratio (PRMR) is defined as the number of pregnancy-related deaths per 100,000 live births. It is a ratio, rather than a rate, because the denominator contains only live births and not all pregnant women who are at risk of maternal death. Where possible, the Health Department compared the PRMR and characteristics of deaths that occurred from 2006 to 2010 to New York City data for the period from 2001 to 2005 and to U.S. estimates for 2006 to 2010.[1] Because pregnancy-related deaths are relatively rare, for most estimates, data are grouped in two five-year periods. The chi-square test was used to examine differences in the PRMR by select maternal characteristics between 2001 to 2005 and 2006 to 2010. The Cochran-Armitage test was used to examine trends in the PRMR from 2001 to 2010.

Key findings of this report include:

- From 2006 to 2010, there were 252 pregnancy-associated deaths in New York City, of which 139 were pregnancy-related.
- Pregnancy-related mortality decreased in New York City from 2001 to 2010 – from 33.9 deaths per 100,000 live births in 2001 to 17.6 deaths per 100,000 live births in 2010. However, there was no significant decrease between 2006 and 2010.
- Black, non-Hispanic women were 12 times more likely than White, non-Hispanic women to die from pregnancy-related causes between 2006 and 2010. This represents a widening of the pregnancy-related mortality gap since the period from 2001 to 2005, when the mortality risk was seven times greater among Black, non-Hispanic women. The increasing gap was largely driven by a 45% decrease in pregnancy-related mortality among White, non-Hispanic women.
- Asian/Pacific Islander women were more than four times as likely and Hispanic women were more than three times as likely as White, non-Hispanic women to die from pregnancy-related causes between 2006 and 2010.
- From 2006 to 2010, the leading cause of pregnancy-related death was hemorrhage, accounting for 27.3% of deaths, followed by embolism (18.7%), pregnancy-induced hypertension (13.7%) and cardiovascular conditions (12.9%).
- From 2006 to 2010, the most common pregnancy outcome among pregnancy-related deaths was live birth (64.7%), followed by ectopic pregnancy (10.8%); in contrast, from 2001 to 2005, 2.5% of all pregnancy-related deaths followed an ectopic pregnancy.

The data in this report speak to the problem of pregnancy-related mortality in New York City and, in particular, its striking impact on Black women. Although the causal relationships for the increased risk of death for Black, non-Hispanic women are not well established, pregnancy-related mortality is associated with obesity, underlying chronic illness and poverty – all conditions that disproportionately affect New York City's Black population. The chronic stress of racism and social inequality also likely contribute to racial disparities in health, such as differences observed in infant mortality, preterm birth and low birth weight,[6,7,8] and may play a role in pregnancy-related mortality, as well. Pregnancy-related mortality also disproportionately impacts Asian/Pacific Islander women and Hispanic women, though not to the same extent as that found among Black women.

The New York City Health Department recognizes that reducing maternal mortality and eliminating the racial/ethnic gap requires attention to a woman's well-being throughout her lifetime, not just during pregnancy. It also requires a particular focus on those communities most impacted – communities with high concentrations of people of color and poverty. Furthermore, it requires an understanding of and willingness to tackle the underlying contributors to maternal mortality, including social inequities and injustices – past and present. Engaging the affected communities in meaningful dialogue is essential for developing a well-considered approach for addressing maternal mortality. While the Health Department is committed to gathering and analyzing the data that help characterize the problem, the agency is equally committed to stimulating and fostering partnerships with stakeholders, clinicians, policymakers and others to combat what has, for decades, been an unrelenting problem.

Definitions

Maternal death (also known as **maternal mortality**) has traditionally been defined as the death of a woman while pregnant or within 42 days of the termination of pregnancy, irrespective of the site or duration of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. This definition is used in reports of maternal deaths based on vital statistics data. However, the term is sometimes used to describe deaths within one year of pregnancy. In this report, maternal death includes deaths within one year of pregnancy that are causally related to pregnancy.

Pregnancy-associated death is the death of a woman from any cause while pregnant or within one calendar year of the end of pregnancy. Pregnancy-associated deaths are further categorized based on whether they are causally related to the pregnancy.

Pregnancy-related death is defined as the death of a woman while pregnant or within one year of the end of pregnancy from any cause related to or aggravated by the pregnancy or its management. In these cases, the pregnancy and death are causally related. Pregnancy-related deaths are a subset of pregnancy-associated deaths.

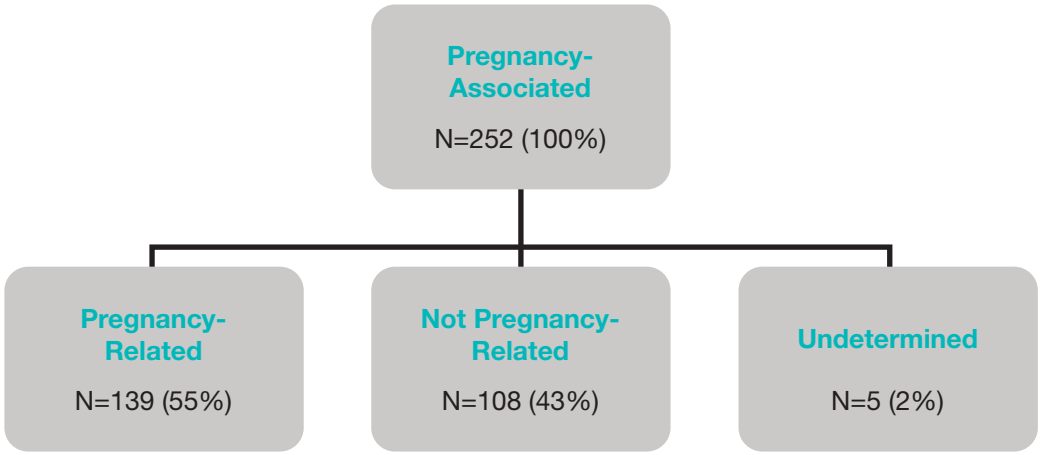
Not pregnancy-related death is defined as a death that is temporally related to pregnancy (i.e., occurring within one year of pregnancy or at the end of pregnancy) but which is not causally related to the pregnancy. These deaths include those due to accidents and homicides. Not pregnancy-related deaths are a subset of pregnancy-associated deaths.

Pregnancy-related mortality ratio (PRMR) is defined as the number of pregnancy-related deaths per 100,000 live births. PRMR is the main indicator in the tables and figures of this report.

Pregnancy-associated mortality ratio (PAMR) is defined as the number of pregnancy-associated deaths per 100,000 live births. This ratio is typically higher than the PRMR because it includes both pregnancy-related and not pregnancy-related deaths.

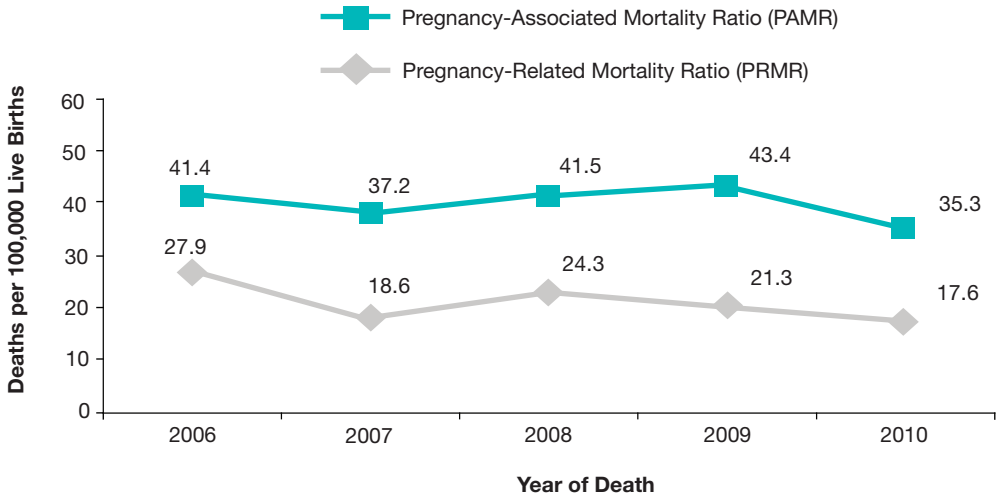
Results

Figure 1. Classification of Pregnancy-Associated Deaths in New York City, 2006 to 2010



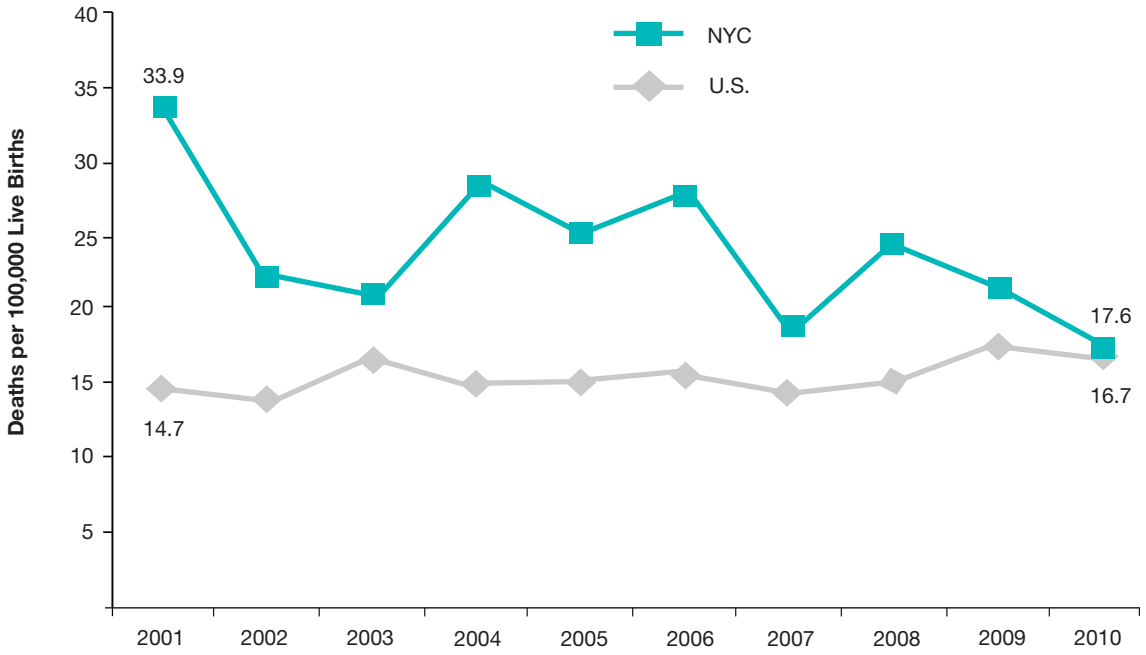
- From 2006 to 2010, there were a total of 252 pregnancy-associated deaths in New York City. Of these, 139 were pregnancy-related, 108 were not pregnancy-related and for five deaths, the relationship between pregnancy and death could not be determined.

Figure 2. Pregnancy-Associated and Pregnancy-Related Mortality Ratios, New York City, 2006 to 2010



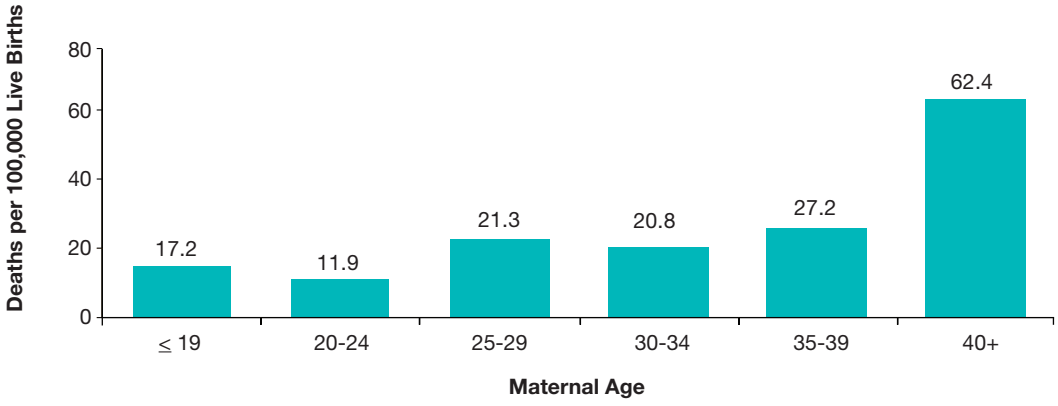
- From 2006 to 2010, the PAMR was 39.8 deaths per 100,000 live births. The ratio ranged from a high of 43.4 in 2009 to a low of 35.3 in 2010.
- From 2006 to 2010, the PRMR was 21.9 deaths per 100,000 live births. The ratio ranged from a high of 27.9 in 2006 to a low of 17.6 in 2010.

Figure 3. Pregnancy-Related Mortality Ratios, New York City and U.S., 2001 to 2010



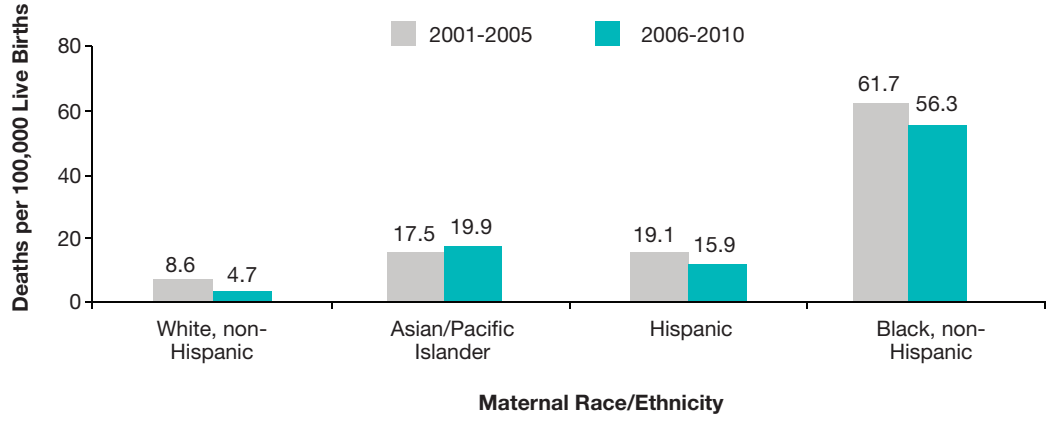
- From 2001 to 2010, the New York City PRMR decreased 48%, from 33.9 to 17.6 deaths per 100,000 live births.
- The U.S. PRMR increased 13.6% from 2001 to 2010, from 14.7 to 16.7 deaths per 100,000 live births.[1]
  - Most deaths occurred in 2009 (17.8 deaths per 100,000 live births), driven largely by the 2009 H1N1 influenza epidemic, which disproportionately affected pregnant women.
- The PRMR was higher in New York City than in the U.S. for every year from 2001 to 2010.[1]

Figure 4. Pregnancy-Related Mortality Ratios by Maternal Age, New York City, 2006 to 2010



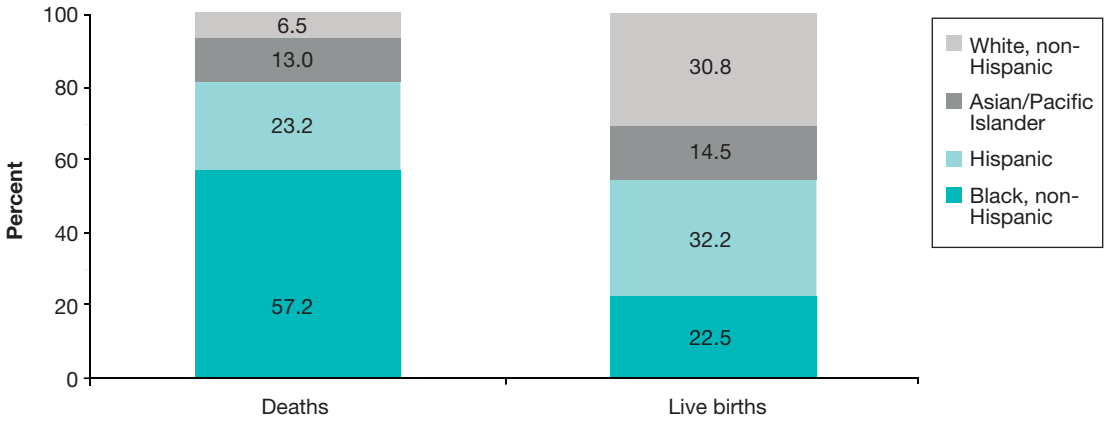
- The PRMR was highest among women aged 40 and older (62.4) and lowest among women aged 20 to 24 (11.9).
- There were no significant changes in the PRMR by maternal age group when compared to the PRMR from 2001 to 2005.

Figure 5. Pregnancy-Related Mortality Ratios by Maternal Race/Ethnicity, New York City, 2001 to 2005 and 2006 to 2010



- From 2006 to 2010, Black, non-Hispanic women (56.3) had the highest PRMR, followed by Asian/Pacific Islander women (19.9), Hispanic women (15.9) and White, non-Hispanic women (4.7).
- From 2006 to 2010, the PRMR for Black, non-Hispanic women was 12 times higher than that of White, non-Hispanic women. This represents a widening of the pregnancy-related mortality gap from 2001 to 2005, when the PRMR among Black, non-Hispanic women was seven times greater. The increasing gap was largely driven by a 45% decrease in the PRMR among White, non-Hispanic women.
- From 2006 to 2010, Asian/Pacific Islander women were more than four times as likely and Hispanic women were more than three times as likely as White, non-Hispanic women to die from pregnancy-related causes.

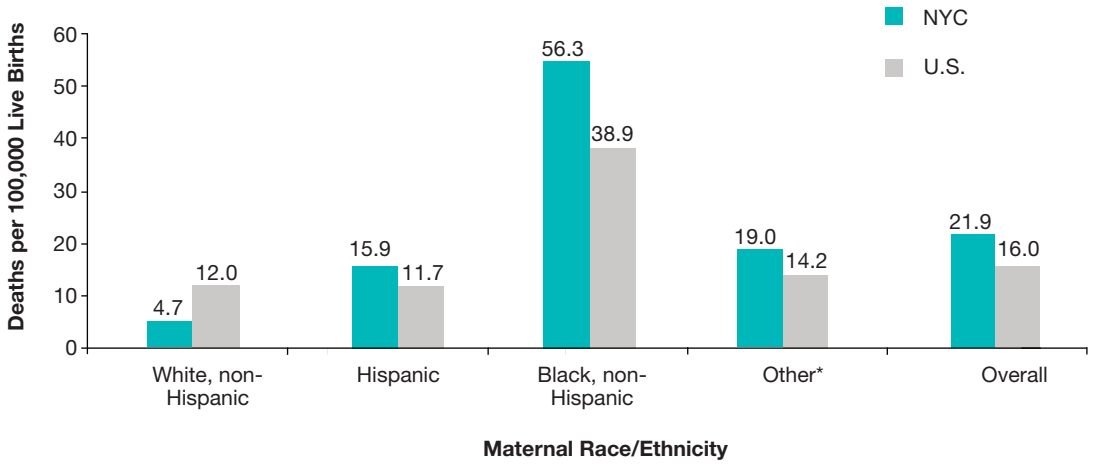
Figure 6. Pregnancy-Related Deaths and Live Births by Race/Ethnicity, New York City, 2006 to 2010



Excludes women from Other and Unknown racial/ethnic groups. Totals may not equal 100% due to rounding.

- Black, non-Hispanic women comprised a disproportionately higher percentage of pregnancy-related deaths (57.2%) compared to live births (22.5%). By contrast, White, non-Hispanic women comprised 30.8% of live births and only 6.5% of pregnancy-related deaths.

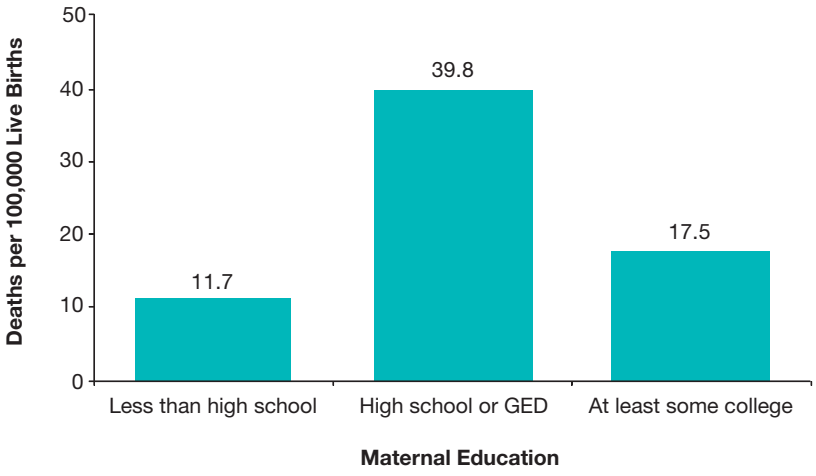
Figure 7. Pregnancy-Related Mortality Ratios by Maternal Race/Ethnicity, New York City and U.S., 2006 to 2010



*Asian/Pacific Islander women are included in the Other category in national reports, and therefore, are grouped as such for New York City data above.

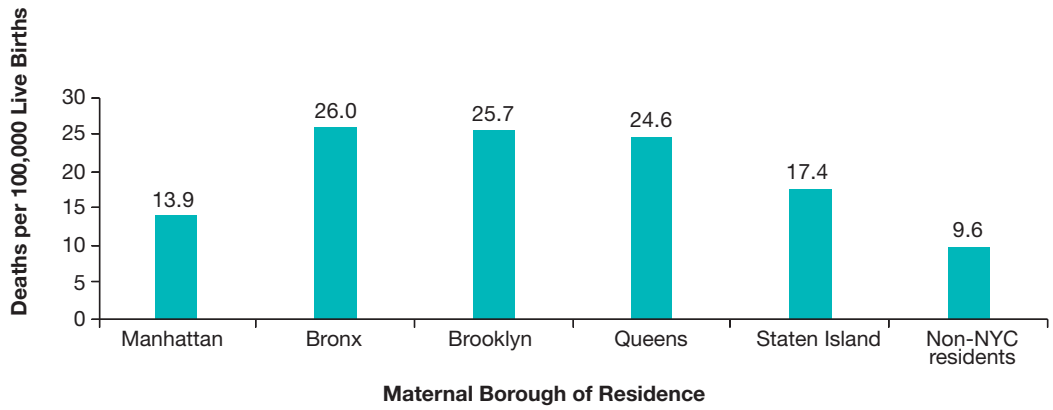
- During 2006 to 2010, the PRMR for the U.S. was highest among Black, non-Hispanic women (38.9), followed by women of Other race/ethnicity (14.2), White, non-Hispanic women (12.0) and Hispanic women (11.7).[1]
- Based on U.S. data from 2006 to 2010, the PRMR for Black, non-Hispanic women was three times higher than for White, non-Hispanic women.[1]
- White, non-Hispanic women were the only racial/ethnic group where the PRMR was lower in New York City (4.7) compared to the U.S. (12.0).

Figure 8. Pregnancy-Related Mortality Ratios by Maternal Education, New York City, 2006 to 2010



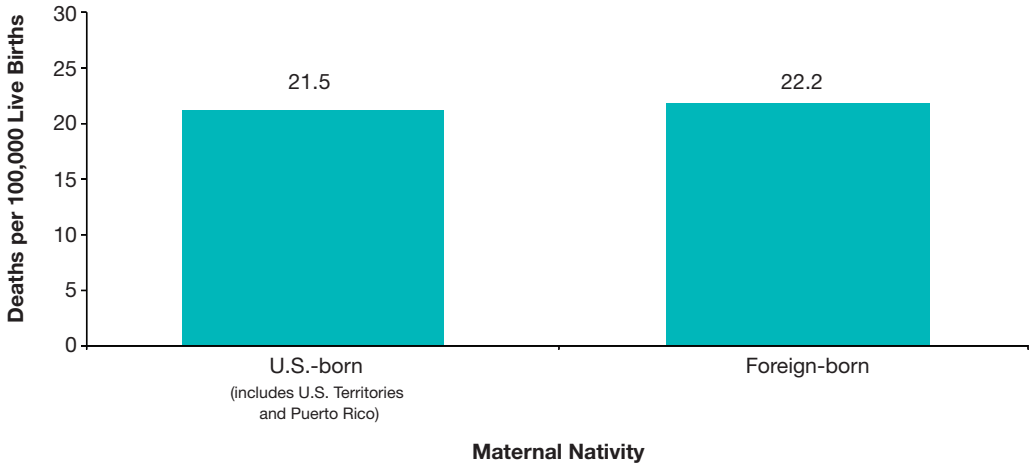
- The PRMR was lowest among women with less than a high school education (11.7), followed by women with at least some college (17.5) and highest among women who had graduated from high school but had no higher education (39.8).

Figure 9. Pregnancy-Related Mortality Ratios by Maternal Borough of Residence, New York City, 2006 to 2010



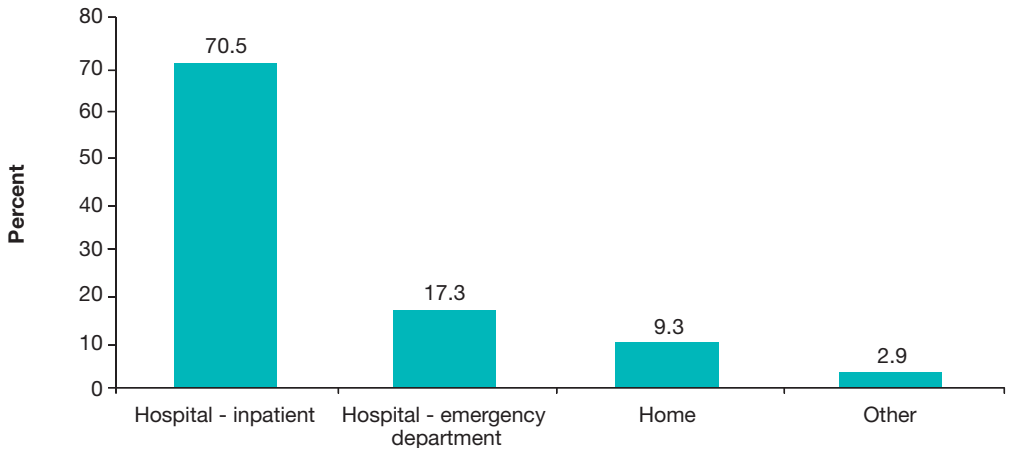
- The Bronx had the highest PRMR (26.0), followed by Brooklyn (25.7), Queens (24.6), Staten Island (17.4) and Manhattan (13.9).
- The borough-specific PRMR remained unchanged compared to 2001 to 2005 data.

Figure 10. Pregnancy-Related Mortality Ratios by Maternal Nativity, New York City, 2006 to 2010



- The PRMRs for U.S.-born and foreign-born women were similar at 21.5 and 22.2, respectively.
- There was no difference in the PRMR by nativity status for Hispanic or Black, non-Hispanic women for 2006 to 2010. (Data not shown.)

Figure 11. **Location of Death for Pregnancy-Related Deaths, New York City, 2006 to 2010**



- The majority of pregnancy-related deaths occurred in the hospital (70.5% inpatient and 17.3% in the emergency department), while 9.3% occurred at home.

Table 1. **Distribution of Pregnancy Outcomes for Pregnancy-Related Deaths, New York City, 2006 to 2010**

Pregnancy Outcome	Number	Percent
Live birth	90	64.7
Ectopic pregnancy	15	10.8
Undelivered	13	9.4
Stillborn (>20 weeks gestation)	11	7.9
Induced termination of pregnancy	6	4.3
Spontaneous termination of pregnancy	2	1.4
Molar/trophoblastic pregnancy	1	0.7
Unknown	1	0.7
Total	139	100.0

- The most common pregnancy outcome among pregnancy-related deaths was a live birth (64.7%).
- Ectopic pregnancies accounted for 10.8% of deaths (n=15). This was an increase from 2001 to 2005, when ectopic pregnancies accounted for 2.5% of deaths (n=4).
  - Nationally, only 3.1% of all deaths occurred as a result of an ectopic pregnancy. Of these, roughly half (55%) occurred in Black, non-Hispanic women. Comparatively, Black, non-Hispanic women comprised 80% of ectopic pregnancy deaths in New York City.
  - Previous research has shown significant racial/ethnic disparities in the ectopic pregnancy mortality ratio; however, it is not clear whether this is the result of increased incidence or a higher case-fatality rate.[9]
- Pregnancy outcomes differed by maternal race/ethnicity. A notably larger proportion of Black, non-Hispanic women (46.8%) died after a pregnancy outcome other than a live birth compared to other racial/ethnic groups. (Data not shown.)

Table 2. Cause of Pregnancy-Related Deaths, New York City, 2006 to 2010

Cause of Death	Number	Percent
Hemorrhage	38	27.3
Embolism	26	18.7
Pregnancy-induced hypertension	19	13.7
Cardiovascular condition	18	12.9
Infection	10	7.2
Cancer	5	3.6
Injury	3	2.2
Anesthesia complication	3	2.2
Other	16	11.5
Unknown	1	0.7
Total	139	100

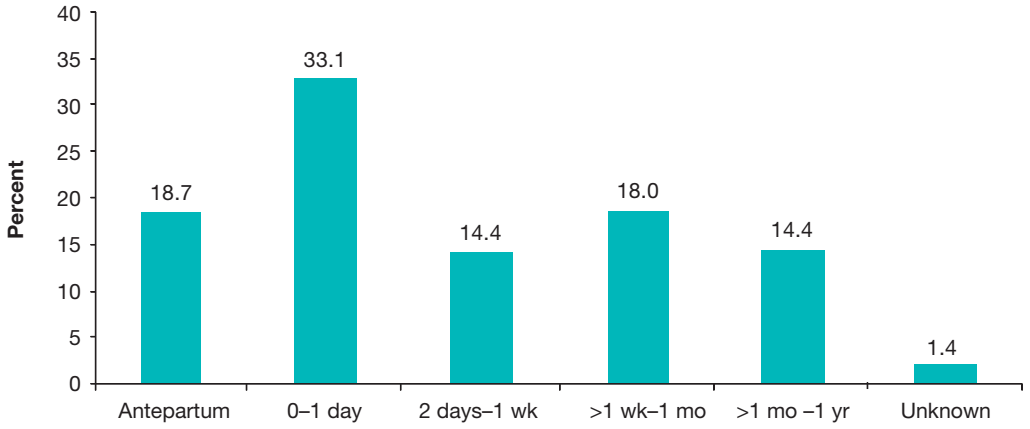
- The leading causes of pregnancy-related death during 2006 to 2010 were hemorrhage (27.3%), embolism (18.7%), pregnancy-induced hypertension (13.7%), cardiovascular conditions (12.9%) and infection (7.2%).
- The proportion of pregnancy-related deaths due to hemorrhage increased significantly during 2006 to 2010 compared to 2001 to 2005, when 16.8% of deaths were due to hemorrhage.
  - Pregnancy-related deaths due to hemorrhage were driven by an increase in ectopic pregnancies.
- Nationally, the leading causes of pregnancy-related death from 2006 to 2010 were embolism (14.9%), cardiovascular conditions (14.6%), infection (13.6%), cardiomyopathy (11.8%) and hemorrhage (11.4%).

Table 3. Cause of Pregnancy-Related Deaths by Race/Ethnicity, New York City, 2006 to 2010

	White, non-Hispanic		Black, non-Hispanic		Hispanic		Asian/ Pacific Islander	
Cause of Death	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Hemorrhage	1	11.1	20	25.3	10	31.3	7	38.9
Embolism	1	11.1	16	20.3	6	18.8	3	16.7
Pregnancy-induced hypertension	2	22.2	12	15.2	4	12.5	1	5.6
Cardiovascular condition	2	22.2	12	15.2	3	9.4	1	5.6
Infection	0	0.0	5	6.3	3	9.4	2	11.1
Anesthesia complication	0	0.0	3	3.8	0	0.0	0	0.0
Injury	1	11.1	0	0.0	1	3.1	1	5.6
Cancer	1	11.1	2	2.5	2	6.3	0	0.0
Other	1	11.1	9	11.4	3	9.4	2	11.1
Unknown	0	0.0	0	0	0	0.0	1	5.6

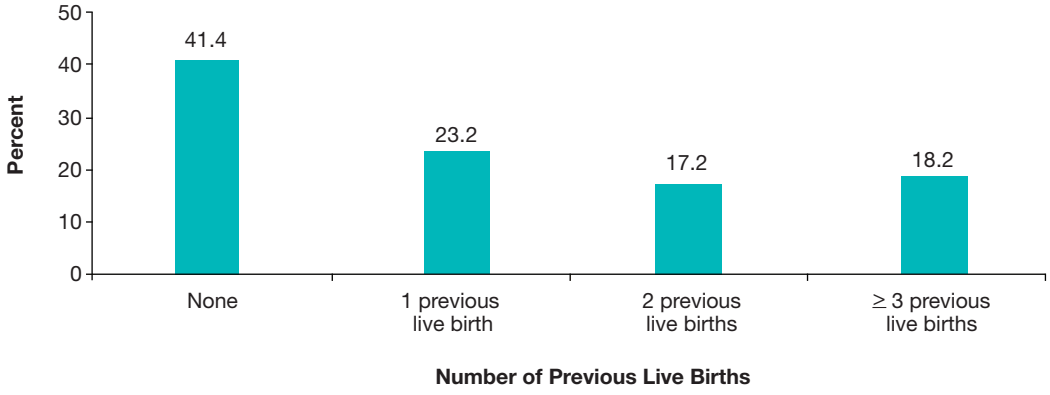
- The leading causes of death for Asian/Pacific Islander, Black, non-Hispanic and Hispanic women were hemorrhage and embolism.
- There was an increase in deaths due to hemorrhage for Black, non-Hispanic women, from 12.9% of deaths during 2001 to 2005 to 25.3% of deaths during 2006 to 2010. This increase was driven by an increase in deaths due to hemorrhage following an ectopic pregnancy.
- In comparison, nationally, traditional causes of pregnancy-related death (e.g., hemorrhage, hypertensive disorders, embolism and anesthesia complications) have declined over time, whereas cardiovascular conditions and infection have increased. (Data not shown.)

Figure 12. **Interval Between the End of Pregnancy and Death, New York City, 2006 to 2010**



- The majority (66.2%) of deaths occurred either antepartum or within one week post-pregnancy.
- One third (33.1%) of pregnancy-related deaths occurred within one day post-pregnancy.

Figure 13. **Live Birth Order Among Pregnancy-Related Deaths, New York City, 2006 to 2010**



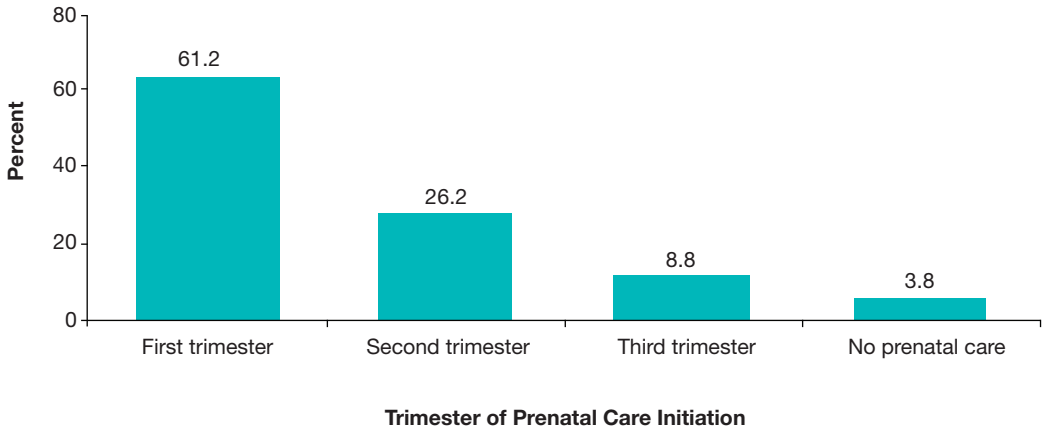
- Among pregnancy-related deaths with known live birth order, 41.4% had no previous live births, 23.2% had one, 17.2% had two and 18.2% had three or more.

Table 4. Pre-Existing Conditions Among Top Five Causes of Pregnancy-Related Deaths, New York City, 2006 to 2010

Cause of Death	Percent		
	≥ 1 Pre-Existing Condition	Obesity	Hypertension
All causes	59.0	30.2	15.8
Hemorrhage	50.0	23.7	2.6
Embolism	53.9	46.2	15.4
Pregnancy-induced hypertension	57.9	26.3	36.8
Cardiovascular condition	94.4	55.6	38.9
Infection	50.0	10.0	20.0

- Among women with a pregnancy-related death, 59.0% had a pre-existing chronic condition. The most common condition was obesity (30.2%), followed by hypertension (15.8%).
- Among the top five causes of pregnancy-related death, women who died of cardiovascular conditions were most likely to have at least one pre-existing condition (94.4%) and to be obese (55.6%).

Figure 14. Trimester of Prenatal Care Initiation for Pregnancy-Related Deaths Resulting in Live Birth or Stillbirth, New York City, 2006 to 2010



- Among women with a live birth or stillbirth, 61.2% initiated prenatal care within the first trimester.

Table 5. Cause of Death When Not Pregnancy-Related, New York City, 2006 to 2010

Cause of Death	Number	Percent
Injury	44	40.7
Cancer	11	10.2
Cardiovascular condition	11	10.2
Infection	7	6.5
Cerebrovascular accident	7	6.5
Neurologic/neurovascular problem	6	5.6
Cardiac arrhythmia	4	3.7
Hematopoietic problem (e.g., sickle cell disease)	4	3.7
Pulmonary problem	4	3.7
Metabolic problem, not pregnancy-related	3	2.8
Immune deficiency problem	3	2.8
Embolism	1	0.9
Collagen vascular disease	1	0.9
Other condition not specified above	1	0.9
Unknown	1	0.9
Total	108	100

- Among deaths not pregnancy-related, the most common cause was injury (40.7%).

Table 6. Types of Injuries Causing Death When Not Pregnancy-Related, New York City, 2006 to 2010

Type of Injury	Number	Percent
Homicide	16	36.4
Suicide	10	22.7
Substance abuse	8	18.2
Motor vehicle accident	6	13.6
Fire	2	4.5
Other	2	4.5
Total	44	100

- Among fatal injuries not related to pregnancy, the most common cause was homicide (36.4%), followed by suicide (22.7%) and substance abuse (18.2%).

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