

Increasing Maternal Mortality in the United States: Looking Beneath and Beyond the Numbers



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The maternal mortality ratio (MMR), defined as the number of maternal deaths due to complications from pregnancy or childbirth per 100,000 live births, is affected by diverse reproductive and maternal morbidities and socioeconomic factors. Significant differences in MMR observed globally reflect inequalities in access to quality health services and highlight the gap between low- and high-income countries. Recent trends indicating that the United States is the only developed country with an increasing MMR have raised significant concerns and discussions. The goal of this perspective is 2-fold: first, to provide a comprehensive analysis of demographic, medical, socioeconomic, and health care factors that may underlie this trend and second, to review strategies employed institutionally and at state levels that are effective in reducing the MMR.^{1,2}

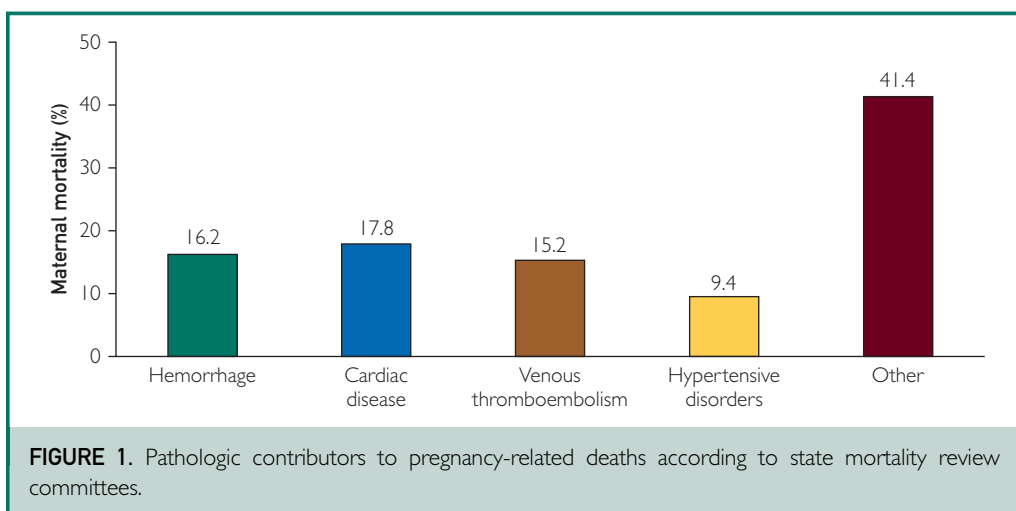
Overview of Increased MMR in the United States

The basis for the increased MMR in the United States reflects the increasing prevalence of relevant risk factors for such mortality and the manner in which such mortality is assessed. Demographic and medical factors that contribute include advanced maternal age at pregnancy; the epidemic of obesity; increased rates of medical comorbidities in pregnant women; unintended births; cesarean deliveries; suboptimal perinatal care with 4 or fewer perinatal visits; and marital status. Improved identification of MMR due to changes in coding and classification practices and death certificate

reporting of maternal deaths also have contributed to these MMR trends in the United States. Globally, maternal mortality is defined by the World Health Organization (WHO) as death occurring when a woman is pregnant or within 42 days postpartum.³ The United States adopted the *International Classification of Diseases (ICD) Tenth Revision* in 1999, allowing inclusion of late maternal deaths from direct or indirect obstetric causes more than 42 days postpartum but less than 1 year after termination of pregnancy.³ This switch in 1999 from the *ICD Ninth Revision* to *ICD-10* was first used by WHO member states in 1994 and resulted in a 13% increase in maternal mortality in the United States due to expanded designations of pregnancy-related deaths.³ A revised US standard death certificate, introduced in 2003,⁴ provides data regarding whether the decedent was pregnant at time of death or, additionally, between 42 days and 1 year of death. The staggered implementation of revised certificates by states resulted in progressive increases in recorded maternal deaths,⁴ accounting by itself for a significant increase of 9.6 maternal deaths per 100,000 live births between 2003 and 2017.⁴ These new indices provide a more accurate assessment of pregnancy-related maternal deaths.

Due to the temporal increases revealed in MMR data after 1999, state maternal mortality review committees were formed as part of an American College of Obstetricians and Gynecologists initiative.⁴ These committee reports revealed that more than 50% of all pregnancy-related deaths were caused by either hemorrhage (16.2%), cardiac disease (17.8%), venous thromboembolism

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(15.2%), or hypertensive disorders (9.4%)³ (Figure 1) and that greater than 60% of pregnancy-related deaths were preventable.⁴

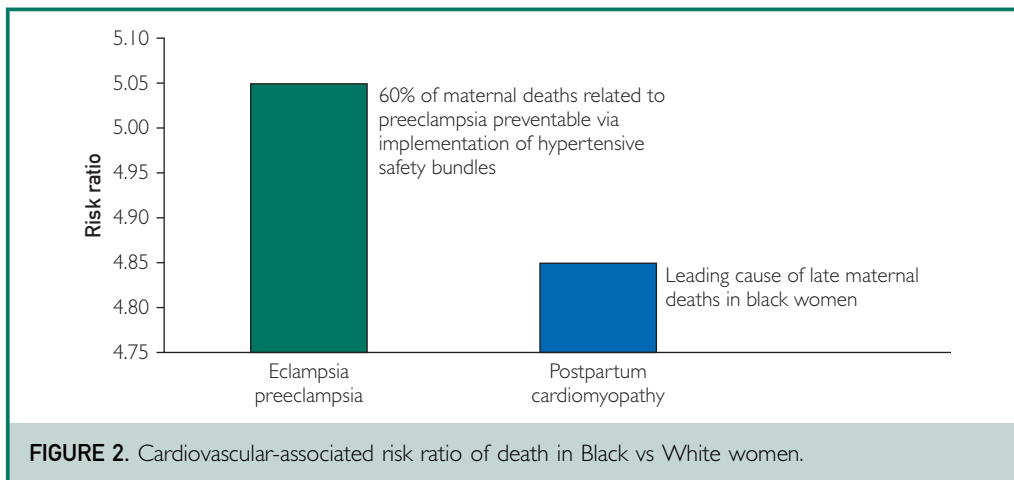
US MMR: Racial Disparity and Other Considerations

When analyzed by race, the MMR data have consistently shown that Black, non-Hispanic women are disproportionately affected. For example, between 2011 and 2013, specific race-ethnicity pregnancy-related MMRs were 12.7, 43.5, 11.0, and 14.4 deaths per 100,000 live births for White, Black, and Hispanic women and women of other races.⁵ The average of the pregnancy-related mortality ratio between Black and White women was 3.4 between 2011 and 2013.⁵

An important consideration is the increasing age of maternal populations. From 2011 to 2013, 30.9% of women who died from pregnancy-related conditions were older than 35 years of age, although less than 15% of births were to women older than age 35.⁵ Black women over age 40 had the highest risk for dying of pregnancy complications at an alarming 191.6 deaths per 100,000 live births.⁵ The risk ratio for death of Black vs White women remained high among all age groups, with teenagers at 2:1, plateauing among women in their 30s (4.8:1), and being slightly lower for women 40 years or older (3.6:1).⁵ An older maternal age and delayed childbearing predispose

women to multiple comorbidities, such as obesity, diabetes mellitus, hypertension, and peripartum cardiomyopathy.^{3,6} Moreover, many of the causes of late maternal deaths uncovered by data analysis based on the *ICD-10* codes and death certificate reportage—pulmonary embolism, cerebrovascular accident, cardiovascular disease, cardiomyopathy—are all diseases in which prevalence increases with age.

The US epidemic of obesity contributes significantly to cardiovascular risk factors in pregnancy, as obese women face a higher risk of hypertensive disorders of pregnancy and gestational diabetes.⁷ Between 2011 and 2013, 16.9% of pregnancy-related deaths occurred in women in whom prepregnancy obesity was recorded.⁵ Cardiovascular diseases were the leading cause of maternal mortality in the United States between 2016 and 2017.^{5,7} Although cardiovascular diseases affect only 1% to 4% of US pregnancies, they accounted for 15.7% of maternal deaths between 2006 and 2010, contributing 4.23 maternal deaths per 100,000 live births.⁸ Cardiomyopathy contributed 11.0% to the MMR.⁸ Together, these leading cardiac conditions cause 25% of the maternal mortality in the United States.⁸ Black women represent only 14.6% of the live birth population but are disproportionally represented, accounting for 37.9% of maternal mortality with 46.8% of the pregnancy-related



mortality in Black women attributable to cardiovascular conditions.⁸ Eclampsia and preeclampsia are the leading causes of death for Black women followed by postpartum cardiomyopathy, with the risk of dying of eclampsia and preeclampsia being 5.1-fold that of White women and postpartum cardiomyopathy risk being 4.9-fold that of White women (Figure 2).⁶ Of maternal deaths related to preeclampsia, 60% are preventable via implementation of hypertensive safety bundles.⁶

Black women with postpartum cardiomyopathy present with more severe symptoms and more advanced disease than White women. Increasing the awareness of cardiovascular diseases in the postpartum primary care setting may improve early diagnosis and treatment, as a significant proportion of cardiomyopathy deaths are considered preventable.⁶

Solutions

The steadily increasing US MMR has spurred actions at state levels, and within specialty services, which have reduced MMRs. The California Department of Public Health, in collaboration with the California Maternal Quality Care Collaborative (CMQCC), developed the California Pregnancy-Associated Mortality Review project in 2006. This initiative seeks to identify pregnancy-related deaths and recommends quality improvements in maternity care, with the goal of ending preventable

morbidity, mortality, and racial disparities in California.¹ Between 2006 and 2013, the CMQCC's work decreased California's MMR by 55% and, indeed, to well below the national MMR, which increased over the same period.¹ The CMQCC established a maternal data center that made real-time data available from more than 200 hospitals (in which 90% of births in California occur), created initiatives such as patient safety bundles to manage hemorrhage and preeclampsia, and conducted research to identify maternal care quality improvement opportunities.¹ Subsequently, more than half of US states now have maternal mortality review committees.⁵ An analysis of administrative data between 2001 and 2014 in Florida supports the effectiveness of pregnancy-related public health spending in reducing the MMR.² Longitudinal data from Florida's 67 counties revealed that each 10% increase in pregnancy-related public health expenditures was associated with a 13.5% decline in Black MMR and a 20% reduction in Black-White disparities.² Florida's initiatives, such as the Maternal Health and Improved Pregnancy Outcome program, provide resources to women, such as nurse home visits and healthy foods to expectant mothers, breast feeding training, and interconception education.² These programs have improved birth outcomes.² Furthermore, given the dominant effect of cardiovascular diseases on MMR, specialty-specific initiatives by

the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine have been implemented with the aim of improving coordination of care between primary and specialty services and improving awareness of cardiovascular disease.⁸ Currently, cardiac risk assessment for maternal mortality is encouraged to begin prior to conception⁹; 4 predictive models—the CARPREG (Cardiac Disease in Pregnancy) I and II, ZAHARA (Zwangerschap bij Aangeboren Hartafwijkingen), and WHO models—may quantify such risk.⁹ These predictive models may aid in creating multidisciplinary pregnancy teams to develop care plans for complex patients.⁸ Institutions with such teams in place have had encouraging outcomes.⁸

The United States is a developed G7 (Group of Seven) nation, and its MMR is unacceptable. The disproportionate contribution to the MMR by Black women reflects the impact of structural racism on health and health care in the United States.^{6,8} Initiatives such as California's CMQCC, Florida's funding models, and the Society for Maternal-Fetal Medicine teams are increasingly effective in addressing this disparity and may be adopted elsewhere. Other important initiatives include those pursued at the hospital level to improve maternal safety, recognizing, nonetheless, the challenges posed by their national implementation across more than 3000 institutions providing obstetric services. Finally, expanded Medicaid coverage should be implemented. Medicaid currently finances nearly half of all births in the United States, and new mothers must requalify for Medicaid coverage 60 days postpartum.¹⁰ As discussed previously, the postpartum period contributes significantly to maternal mortality and is an entirely opportune time for cardiovascular screening and management of chronic cardiovascular conditions.¹⁰ Medicaid extension to provide 1 year of postpartum coverage will substantively promote health care delivery during this high-risk period.¹⁰

The alarming increase in maternal mortality in the United States and all that it entails is insufficiently recognized. Promoting

such awareness and seeking effective initiatives at local, institutional, state, and federal levels, and ones that involve multidisciplinary considerations and approaches, are now all urgently needed.

POTENTIAL COMPETING INTERESTS

The authors report no competing interests.

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