

Preventability Associated with Elevated Maternal Mortalities Among Black Women

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Abstract

Background: Maternal mortality is defined as the deaths of women during pregnancy while giving birth or soon after birth. The United States is the only developed country having a continuous rise in maternal mortality, with Black women being at the highest risk compared to other racial and ethnic groups.

Methods: Data from the CDC WONDER database was used to analyze preventability associated with maternal mortality among Black women from ages 15 to 55 between the years 2010 to 2019. Demographic statistics such as age, year, and geographic location were utilized to complete this analysis. Only preventability associated with antenatal and perinatal maternal deaths among Black women in the United States was examined.

Results: From 2010 to 2019, Black women in the United States experienced statistically significant increasing rates of preventable maternal mortality ($p < 0.05$); statistically significant association was indicated with age group (AMA and non-AMA) ($p < 0.005$) and geographic location (urban and rural) ($p < 0.005$).

Conclusion: Further research is needed to analyze the racial disparities associated with Black women experiencing a higher maternal mortality rate compared to other racial and ethnic groups. In addition, health care policies and social determinants in other countries need to be investigated to develop new interventions aimed at improving maternal care of Black women in the United States.

Introduction

The United States is the only developed country experiencing an increase in maternal mortality, which is a public health crisis in need of critical examination (1–3). Maternal mortality is defined as the deaths of women during pregnancy while giving birth or soon after birth (4). Maternal age is commonly divided into two classifications: non-advanced maternal age (non-AMA) which includes ages 35 and under and advanced maternal age (AMA) which includes ages above 35 during pregnancy (1). The World Health Organization (WHO) divides maternity care into three parts: antenatal, perinatal, and postpartum care (5). Antenatal care focuses on promoting health and wellness through education and referrals (6). Perinatal care, from 22 weeks of gestation through 1 week following birth, includes palliative and preventive measures for mother and child, although maternal mortality rates are highest during this time (7–9). The final phase is postpartum care, and this refers specifically to the mother's care (10). For this study, we considered the antenatal and perinatal phases of pregnancy-related maternal deaths.

Racial and ethnic disparities in obstetric care and delivery outcomes have shown that Black women experience higher rates of pregnancy-related mortality and morbidity compared to other racial and ethnic groups (11). The condition of the hospital, in addition to the care provided, contributes to the patient outcome. A recent investigation found that racial and ethnic minority women deliver in lower-quality hospitals than white women and receive lower-quality care; this is believed to be correlated with more severe morbidity in Black women (12). Studies indicate that Black women are 2.4 to 3.3 times more likely to die from pregnancy complications than their counterparts in other racial and ethnic groups (12, 13). Additionally, Black women endure substantially higher cesarean delivery rates, which leads to further postpartum complications in addition to the widely known risks involved in major abdominal surgery (12, 13). In Black women, 46% of pregnancy-related deaths could have been prevented compared to 33% of white women (14). Black women experience elevated rates of pregnancy-induced conditions such as chronic hypertension, asthma, placental disorders, gestational and preexisting diabetes, and blood disorders (15). However, no direct correlation has linked these pregnancy-induced conditions to the disparities surrounding maternal mortality rates of Black women in the United States (12).

There is no explanation for why there has been a failure of health care providers to acknowledge these known disparities. Preventive measures are not readily available and accessible to all pregnant women; most notably in regard to hospitals in which Black women predominantly give birth (12). Based on a literature review, this study's definition of prevention includes continual health checks, logistical access to health resources and nutrition, ability to obtain and take medications, and managing chronic illness and stress (9). There is an undeniable need to improve prenatal and delivery care in the United States, specifically in low-performing hospitals serving a disproportionate ratio of Black women (12). Structural and environmental racism consistently underlie the higher maternal mortality rates for Black women. An approach that generates quality care throughout pregnancy from preconception to postpartum care will be most effective in reducing maternal mortality (12, 16). This study examines associations of common population level factors, such as age and geographic location, to antenatal and perinatal maternal preventable and non-preventable deaths among Black women in the United States.

Methods

Participants

Black females between the ages of 15 to 55 with a cause of death related to pregnancy, childbirth, and puerperium were selected for analysis. The most recent publicly accessible version of the NCHS Urban-Rural Classification Scheme from 2013 was used to categorize the geography of deaths in the database, and no classifications were excluded (17). Inclusion criteria consisted of all weekdays, autopsy values, and all death locations within the United States in order to have comprehensive data that reflects all maternal mortalities within the research parameters. Women of Hispanic, non-Hispanic, or unspecified origin were also included for this investigation. Death rates occurring from certain conditions (see Table 1) originating after the puerperium period (over 42 days following birth) were excluded due to the results being outside the range of the study. Based on these criteria a sample of approximately 2,700 women were analyzed out of the over 21,000 maternal mortalities in the U.S.

Procedures

This study utilized secondary data analysis with data obtained from the Centers for Disease Control and Prevention's Wide-ranging Online Data for Epidemiologic Research (CDC WONDER) database (18). Starting in 1999, all death certificates in the United States are sent to the CDC and are compiled into the WONDER database. The secondary data analysis focused on maternity-related deaths of Black women from 2010 through 2019 and was collected from the WONDER database on January 29, 2021. Table 2 shows detailed description of variables and criteria entered into database search to obtain the appropriate sample. Demographic statistics such as age, year, geographic location, and preventability were assessed. In order to complete the analysis, causes of death were operationalized into nominal categories: Preventable, Non-preventable, and Undetermined. Causes of death were connected to public and community health resources based on published literature pertinent to the time frame of 2010 through 2019 as they fit into this study's operationalized definition of preventable (19).

Data analysis

Age at the time of death was examined on a nominal scale including non-AMA (age ≤ 35) and AMA (age > 35) pregnancy groups (18). Geography was used as a variable in nominal categories defined as rural or urban location of death as defined by the 2013 NCHS Urban-Rural Classification Scheme (17). The primary variable examined, which was compared to all other variables, was whether a cause of death is considered preventable. Preventability for each cause was defined by an extensive literature review in combination with this study's definition. Preventable causes were defined as causes that could have been prevented if a mother had continual health checks, logistical access to health resources and nutrition, the ability to obtain and take medications, and the ability to manage chronic illness and stress (9). Each ICD-10 code was compared with this definition. If a cause met these criteria, it was designated as preventable. If a cause did not, it was non-preventable. If a cause was situationally dependent such as complications from anesthesia or clinical mistakes, it was designated as non-defined to exclude inconclusive data. Deaths considered preventable and not preventable were the primary focus of data analysis.

This research used descriptive analyses with the quantitative data. Statistical analyses consisted of chi-squared tests. A chi-square analysis was used to evaluate the preventability of death in Black women versus age during pregnancy.

Preventable ICD-10 Codes: N=46	Non-preventable ICD-10 Codes: N=35	Non-defined ICD-10 Codes: N=34
O03.1, O03.5, O03.6, O03.7, O06.6, O06.7, O07.5, O07.6, O10.0, O10.1, O10.2, O11, O12.0, O13, O16, O21.0, O22.3, O23.0, O23.5, O24.0, O24.3, O24.4, O24.9, O25, O26.8, O36.5, O41.1, O42.9, O62.2, O63.9, O72.0, O72.1, O72.2, O72.3, O73.0, O75.1, O85, O87.0, O87.3, O88.2, O90.4, O98.0, O98.5, O98.7, O98.8, O99.2, O99.4, O99.6	O00.1, O00.8, O00.9, O01.9, O02.1, O03.9, O04.7, O14.0, O14.1, O14.2, O14.9, O15.0, O15.2, O15.9, O26.6, O30.0, O34.1, O34.5, O36.4, O43.1, O43.2, O44.1, O45.9, O46.0, O46.8, O46.9, O67.8, O67.9, O71.1, O71.4, O88.1, O90.3, O99.3, O99.5, O99.7	O02.9, O03.3, O03.8, O04.8, O05.1, O05.8, O05.9, O06.8, O06.9, O07.3, O07.8, O20.9, O22.9, O26.9, O29.1, O68.9, O71.5, O74.8, O74.9, O75.4, O75.9, O87.9, O88.0, O89.8, O90.8, O90.9, O95, O97, O97.0, O97.1, O97.9, O99.0, O99.1, O99.8

Table 1. ICD-10 Code Classification

CDC WONDER Criteria	Entry
Group Results By	Cause of Death
Location	By State
States	*All* (The United States)
2013 Urbanization	All Categories
Single Year Ages	15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55
Gender	All Genders
Race	Black or African American
Hispanic Origin	All Origins
Years	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Weekday	All Weekdays
Autopsy	All Values
Place of Death	All Places
ICD Code	ICD-10 Codes
ICD Codes	O00-O99 (Pregnancy, childbirth and the puerperium)
Exclusion from results: ICD Codes 096-096.9 due to deaths occurring over 42 days after birth, this is outside of the range for this study.	

Table 2. CDC WONDER Request Form Entry Criteria, Retrieved: January 30, 2021

Several chi-squared tests comparing the preventability over time were run to capture the difference in preventability of deaths per year to examine the trends. A chi-squared test was run to find differences between preventability and urbanization. Lastly, a chi-square analysis was used to compare the top five causes of death and their preventability. The data was exported directly from the CDC WONDER database. These data were analyzed on GraphPad online software for statistical analyses, and figures were prepared with GraphPad Prism, version 9.0.2 (20, 21).

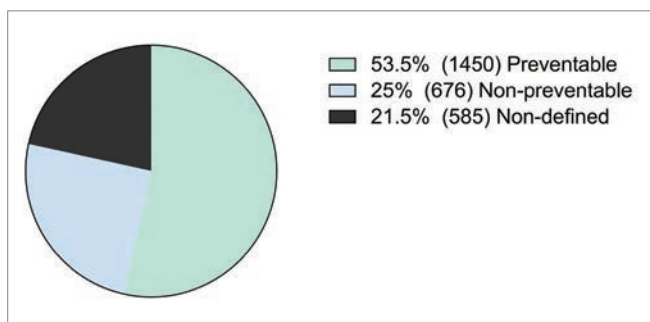


Figure 1. Maternal mortality of Black women from 2010 to 2019 categorized as preventable (53.5%), non-preventable (25%), or non-defined (21.5%) as reported by the CDC WONDER database.

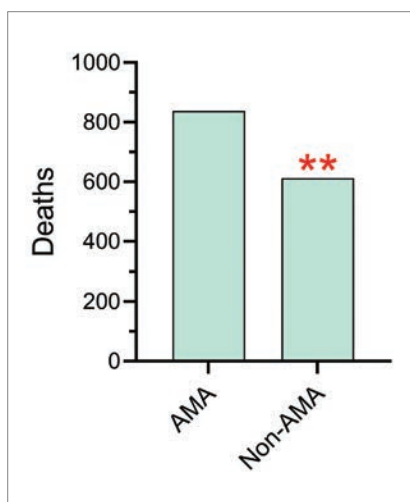


Figure 2. Preventable maternal deaths of Black women from 2010 to 2019 as reported by the CDC WONDER database in AMA (age >35) versus non-AMA (age ≤35) pregnancies (** = $p < 0.005$).

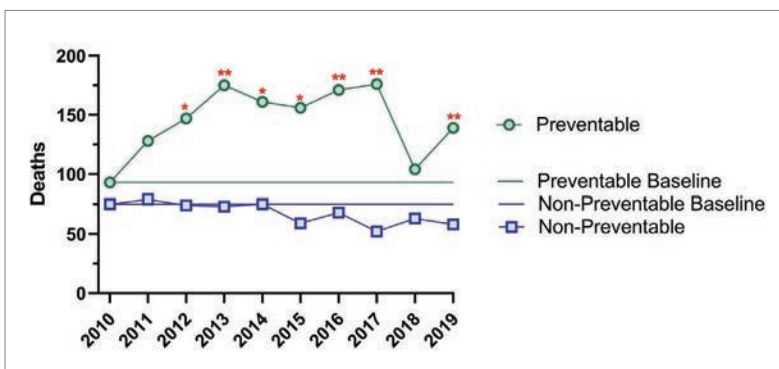


Figure 3. Preventable and non-preventable maternal deaths of Black women from 2011 to 2019 compared to preventable and non-preventable deaths of 2010 as a baseline as reported by the CDC WONDER database (* = $p < 0.05$, ** = $p < 0.005$).

Results

Preventability associated with maternal mortalities among Black women from ages 15 to 55 were examined from 2010 to 2019. The preventable versus non-preventable proportion of maternal mortalities among Black women is presented in Figure 1. Figure 1 presents the death with the highest rates of preventable deaths with 53.5%, followed by non-preventable deaths with 25.0%, followed by non-defined deaths with 21.5% among Black women from 2010-2019.

Preventability associated with maternal mortalities among Black women comparing non-AMA and AMA groups are presented in Figure 2. Figure 2 displays a higher number of deaths for both preventable and non-preventable deaths among AMA Black women compared to non-AMA Black women from 2010 to 2019, presenting significant values ($X^2 (1) = 29.642$, $p \leq 0.0001$). The odds of experiencing a preventable death during AMA pregnancies is 1.71 times the odds of experiencing a preventable death during non-AMA pregnancies.

Figure 3 shows a steady trend of non-preventable deaths from 2010 to 2019 ($X^2 (1) = 10.106$, $p = 0.0015$), 2016 ($X^2 (1) = 11.348$, $p = 0.0008$), 2017 ($X^2 (1) = 21.17$, $p \leq 0.0001$), and 2019 ($X^2 (1) = 9.047$, $p = 0.0026$). In 2013, there were the highest number of preventable deaths compared to non-preventable deaths. In 2018, there was a decline in preventable deaths with a subsequent increase in 2019. There was a significant increase for preventable deaths in 2012 ($X^2 (1) = 5.029$, $p = 0.0249$), 2014 ($X^2 (1) = 6.956$, $p = 0.0084$) and 2015 ($X^2 (1) = 12.267$, $p = 0.0005$).

Preventability associated with maternal mortalities among Black women comparing rural and urban geographic locations are presented in Figure 4. Figure 4 exhibits significantly higher numbers for both preventable and non-preventable deaths among Black women living in an urban environment compared to a rural environment from 2010 to 2019 ($X^2 (1) = 14.704$, $p \leq 0.0001$). The odds of experiencing a preventable death in a rural area is 2.29 times the odds of experiencing a preventable death in an urban area.

Preventability associated with maternal mortalities among Black women comparing the top five causes of death to other causes of death are presented in Figure 5. There is a significantly higher number of preventable deaths caused by the top five

causes of deaths (pre-existing hypertensive heart disease complicating pregnancy, other specified pregnancy-related conditions, obstetric blood-clot embolism, cardiomyopathy in the puerperium, and diseases of the circulatory system complicating pregnancy; ICD codes 010.1, 026.8, 088.2, 090.3, and 099.4) among Black women, as well as a significantly higher number of non-preventable deaths due to other causes among Black women from 2010 to 2019 ($X^2 (1) = 368.044$, $p \leq 0.0001$). Figure 5 shows the summaries of the age, geographic, and top five causes explorations.

Discussion

This study supports the notion that Black women have alarmingly high rates of preventable deaths over deaths of preventable causes, and there are

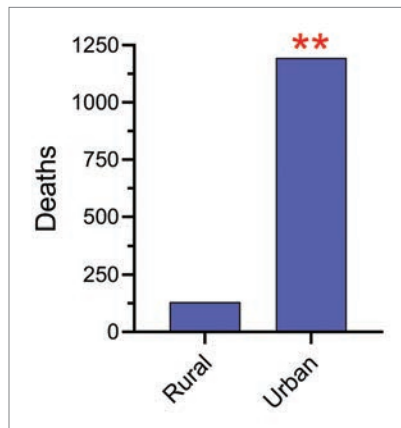


Figure 4. Preventable maternal deaths of Black women from 2010 to 2019 as reported by the CDC WONDER database in rural versus urban locations (** = $p < 0.005$).

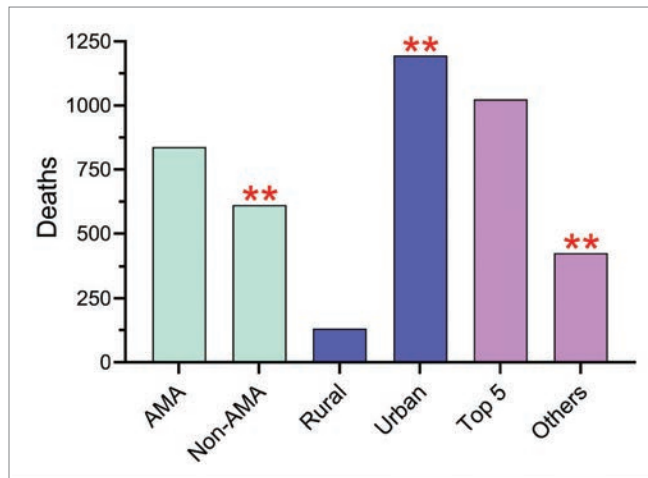


Figure 5. Preventable maternal deaths of Black women from 2010 to 2019 as reported by the CDC WONDER database in AMA versus non-AMA, rural versus urban, and top five causes of deaths versus all other causes of deaths (** = $p < 0.005$).

associations with age and geography. In both age groups, AMA and non-AMA, the data consistently displays more preventable maternal deaths than non-preventable maternal deaths for Black women. This proportional trend generally continues from 2010 to 2019 (Figure 2). Looking at 2010 preventable and non-preventable deaths as a baseline, maternal Black women are dying significantly more from preventable deaths than from non-preventable deaths. Specifically, the years 2012–2017 and 2019 show a significantly higher number of preventable deaths than the baseline in 2010. In respect to geographical distribution of rural versus urban areas (Figure 4), there are significantly more preventable maternal deaths than non-preventable maternal deaths for Black women. In contrast to all other causes of death, the top five maternal mortality causes for Black women are significantly preventable (Figure 5).

These data further uncovered the reality of maternal care for Black women in the United States, exposing the need for new public health interventions to improve this area of medicine. The findings from this study indicate that maternal mortality for Black women is primarily from preventable factors and illustrates the need for interventions to avoid Black maternal preventable deaths. In accordance with these findings, studies

surrounding racial and ethnic disparities in obstetric care and delivery outcomes have shown that Black women experience higher rates of pregnancy-related mortality and morbidity compared to all other racial and ethnic groups (11, 12).

There are many complex reasons why Black women are more susceptible to preventable maternal deaths, including factors such as the lack of access to quality medical care, community resources, and low-quality obstetric care. Further explanation of these results could be due to societal factors such as lack of access to quality care and systemic, personal, and environmental racism leading to active discrimination contribute to these disparities. The increase over the 10-year period could be explained by increasing prevalence of effects from various forms of racism. Discrimination caused by racism of health care workers and the health care system itself leads to significant disparities in clinical care and implementation of anti-racism intervention is paramount (22).

Anti-Black hatred is part of American culture and Black populations have been imposed to live in underserved and physically unhealthy locations (23). The effects of environmental racism continually intensify due to global climate change causing increased health risks and poor outcomes (23). For the AMA and non-AMA comparison, the association could be explained by the increased risk of complications associated with AMA pregnancies in general, as AMA is a strong independent risk factor for morbidity (24). Knowing this association, more frequent and diligent testing and care may reduce the increased odds of preventable deaths in the AMA population. For the urban versus rural exploration, access to community health resources is limited in rural areas, and the increased odds of preventable maternal death in rural areas is likely due to this and other disparities (25, 26).

The extent and depth of this research was limited due to data suppression when less than 10 deaths occurred sub-nationally (27). Additionally, data is defined as unreliable when the death count is below 20 (27). As this database solely collected data about cause of death, no exact conclusions can be drawn about specific contributing factors on a population or individual level. The data used is comprehensive, as no data was suppressed or hidden at the national level of this analysis. Due to the large sample size, over 2,700, results are reliable and have high statistical power. Further research is needed to compare preventable and non-preventable maternal deaths based on racial and ethnic groups in the United States. Furthermore, investigation on proposed actions to limit preventable deaths should be considered to determine their effectiveness. For a more comprehensive analysis, future research should compare the data on maternal outcomes to other countries. An investigation into best practices from countries with low maternal mortality rates among Black women can help provide a blueprint to solutions for United States health care systems.

Conclusion

There is an alarming rate of maternal mortality among Black women in the United States. The findings from this study reveal the incline in mortality rate for Black women from 2010 to 2019 stem primarily from preventable causes. When compared to their counterparts, Black women have been reported to possess elevated risk factors from preexisting conditions and

pregnancy-induced conditions. Approaches that highlight the need to better understand how social determinants such as socioeconomic status, community, behaviors, beliefs, and barriers to quality care can be addressed to promote optimal outcomes for Black women (15). The United States healthcare system and government need to address racial and ethnic disparities within the maternal mortality crisis by grounding in equitable quality health improvement measures by utilizing comprehensive analyses of race, poverty, and access to health care, with individual narratives as a framework from a human-rights approach (28). Elimination of the racial disparities surrounding maternal mortality should be of utmost importance for the United States. Further research is needed to examine maternal mortality related to maternity care of Black women during antenatal and perinatal phases, as well as during postpartum care, which was not examined in this study. Health policies and social determinants within countries that have low Black maternal mortality also need to be investigated to understand the intricacies of health disparities and interventions that can improve the maternal care of Black women in the United States.

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Disclosures

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