
The Effect of Healthcare on Maternal Mortality Rates

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Abstract

The United States has one of the highest maternal mortality rates among the developed nations, at 20.1 maternal deaths per 100,000 births as reported in 2019. The nation has done little to lower this rate in the past decade, and the maternal mortality rate has increased from the 17.4 maternal deaths per 100,000 live births rate in 2018. The maternal mortality rate for non-Hispanic black women in the US was 2.5 times the rate for non-Hispanic white women in the US. We wanted to determine how healthcare services and insurance coverage play a role in the high maternal mortality rates in the United States, with a focus on the maternal mortality of black women. Due to the nature of our study, we focused on collecting and analyzing archival data instead of conducting a survey or interviews. Our methodology focused on collecting data that we ran multiple linear regression tests on. Unfortunately, there has been a lack of reporting in maternal mortality cases in general, and even more so in the cases of women of color. Therefore, it is crucial that more reporting and further research is done to lower these rates and understand these racial disparities.

Categories: Women, Mortality, Healthcare

Keywords: United States, Mortality Rate, Healthcare, Infant

Literature Review

Mortality in the US

The United States continues to lag behind other developed countries in terms of healthcare access and lifespan. Much academic research has suggested that countries that have more equitable healthcare access and more robust healthcare systems have better mortality rates. For instance, Heijink et al. (2011) finds that countries with above-average spending in healthcare have above-average reductions in mortality. Unfortunately, the researchers found the link between these two factors is weakest in the US, where healthcare spending does not have a large effect on mortality. Despite the fact that the US spends far more money per capita on healthcare- healthcare spending is 18% of its GDP(Gross domestic product), and the US accounts for nearly 40% of pharmaceutical spending worldwide lifespans in the US are not higher than other developed countries, and in many aspects, mortality rates are worse (Yoe, 2020). The reason for the disparity in healthcare spending and life expectancy in the US is because healthcare is distributed unevenly. Among Americans who have healthcare in the first place, high-income Americans are more likely to utilize healthcare services than low-income Americans, regardless of how “necessary” the service is. This disguises the racial inequality prevalent in the U.S. Specifically, the wealthy - a minuscule population in terms of size - account for 58.7% of healthcare expenditure (Chen & Escare, 2004). Essentially, while as a country, the US may spend a large amount of money on healthcare, this healthcare first and foremost goes to the wealthy. It is unlikely that healthcare services will naturally become more evenly distributed across income groups in the next few years, as research suggests that the wealthy have better healthcare utilization across all age groups - young and old. Unfortunately, the fact that healthcare is functionally a “luxury” that only the wealthy in the US can afford is causing major discrepancies in mortality. Inadequate healthcare access is one of the main causes of the US’s poor mortality rates compared to other countries. Interestingly, the life expectancy of seniors (above the age of 65) is less affected by the US’s lack of universal healthcare because American seniors qualify for Medicaid. Medicaid allows seniors to be screened for chronic diseases at the earliest stages, resulting in the US actually having better cancer identification and survival rates (National Research Council, 2011). Therefore, the negative effects of inadequate healthcare are mostly visible in the younger cohort of Americans.

One critical area of mortality the US continues to perform badly in is maternal mortality. Indeed, over the last few years, research suggests that maternal mortality is actually increasing. Khozimannil et al. (2019) report that that severe maternal morbidity, the state of being unhealthy for a particular disease, and mortality, the number of deaths that occur in a population, increased among both rural and urban residents from 109 per 10,000 childbirth hospitalizations to 152 per 10,000, from 2007-2015. Importantly, the study also notes that the largest increase in maternal mortality was specifically in rural areas, suggesting that more research needs to be done into the causes of the rural increase to generate solutions to the problem. The issue of maternal mortality is closely linked to the quality of healthcare and hospital care which effectively is a socio-economic situation of the United States. In the US, 39% of people have reported not going to a

doctor because of concerns about cost, compared with 7% in Norway and Canada, 5% in Sweden and just 1% in the UK - all countries with public healthcare systems (Christiansen, 2017). However, most maternal deaths are preventable with adequate care. With a more affordable, efficient healthcare system, expecting mothers would never be denied or refuse valuable treatment because of cost concerns.

How does location affect mortality?

On the whole, mortality in the United States has been on the decline. Unfortunately, mortality is not indiscriminate. The largest reductions in mortality for many diseases have concentrated in very specific areas of the US. For instance, for white Americans in urban areas, there was a 43% reduction in mortality from coronary heart disease, while mortality was reduced far less among black and rural populations (Kulshreshtha et al., 2014). Heart disease is currently the leading cause of death in the US (Gillespie et al., 2014), so the discrepancies in mortality need to be urgently addressed.

On the whole, rural counties have lower life expectancies than their urban counterparts and are more unhealthy. James et al. (2018) finds that of the 417 rural counties with persistently high rates of mortality, 75% of them are rural counties. These high-mortality rural counties are distributed throughout all regions of the US, although many are in the Southeastern region.

How does race affect mortality?

While the mortality gap has declined slightly between black and white Americans (Masters et al., 2014), discrepancies still exist. Mortality reduction has been the weakest among black populations across the US. When comparing the mortality from preventable diseases like coronary heart disease, black and white Americans in similar geographic settings had very different outcomes. Kulshreshtha et al (2014) report that the mortality rate for black people in large urban areas was 215 per 100,000, while for white people it was 143 per 100,000.

In total, health inequalities result in shorter lifespans for Black Americans throughout the US. In 2010, the life expectancy for white Americans was 4.1 years longer than the expectancy for black Americans (Murphy et al., 2013). These statistics suggest that while the quality of life might be improving for the United States, these improvements are mostly enjoyed by white Americans.

How does healthcare affect mortality?

As stated before, many maternal deaths are preventable with adequate care, yet the US lags behind other countries in healthcare accessibility. Unfortunately, an estimated 15% of women in the US do not receive adequate prenatal care (National Vital Statistics Report, 2018). These numbers are not distributed equally across demographic groups; lower rates of prenatal care occur

amongst groups that typically have less healthcare access. Furthermore, the type of payment method used to pay for the delivery of a baby was strongly correlated with how likely a woman was to begin prenatal care. For women who paid out-of-pocket, 54.8% received PNC in the first trimester compared with 68.1% of women for whom Medicaid was the source of payment, and 87.0% of women with private insurance. Beginning prenatal care in the first trimester is key in protecting a mother's life; over 88% of women who received prenatal care in the first trimester are classified as having adequate care, meaning it was constant throughout the remainder of the pregnancy.

Likewise, infant mortality is an issue closely linked to healthcare access in the US. Health expenditures on newborns are extremely high; the average 6-month expenditure for preterm infants was \$76,153 (Beam et al., 2016).

The gap in maternal morbidity research

While academic research in the US has continually affirmed that location and race impact mortality rates, there is limited research on the intersection of location and race. Current literature has conclusively told us that black mothers throughout the US have much higher rates of mortality. For instance, in California, a state that tackled the issue of maternal mortality in the mid-2000s and was successful in lowering the death rates, black mothers are still three-four times more likely than white mothers (Main et al., 2018). The researchers suggest there are a variety of reasons why black women continue to have much higher rates of maternal mortality, with underlying reasons including lack of hospital access, poor quality of hospitals and healthcare, but racism and social determinants also factor into mortality rates.

The goal of our paper is to gain an understanding of whether geographic location affects the maternal mortality of black women. Research suggests that rural dwellers have higher mortality rates, and black Americans have higher mortality - and specifically much higher rates of maternal mortality. Indeed, the mortality risk for rural black Americans is two to three times higher than urban whites across the country. Worryingly, the mortality gap between rural black Americans and urban white Americans is increasing (James & Cossman, 2016). Thus, our paper aims to holistically analyze the reality of health outcomes for pregnant women and newborns across the US. We look at factors such as race, healthcare access, and location by state to see how these impact maternal and infant mortality.

Materials & Methods

For our study, we defined maternal mortality as the death of a woman from any cause related to pregnancy, childbirth, or 42 days within the termination of a pregnancy. The large gap in research on maternal and infant mortality, in general, prompted us to investigate using a two-pronged approach to explore how several variables, including race and healthcare access, change health outcomes for these two populations, pregnant women and newborns.

Part 1: Maternal Healthcare Services

In order to look at the performance of each state's maternal care holistically, we compiled a spreadsheet of maternal health insurance and care services provided by each state. We assigned a 1 to each service that a state-provided and a 0 to each service that a state did not provide (every service was equally weighted). We then totaled each state's points for a total of 16 possible points to determine which states offered the most support and which states offered the least support. Below are the services that we considered:

Medicaid Expansion: State has expanded its Medicaid coverage as of March 31st, 2021, allowing more affordable coverage options and ultimately decreasing the number of uninsured women. This data was retrieved from the Kaiser Family Foundation (Family Foundation 2021).

Paid Family Leave (PFL) as of January 18th, 2021: State has a state-mandated law in place that provides employees with paid family leave. Employees in this state can receive wages when they take time away from work to take care of a new child or ill family member. This data was retrieved from Patriot (Blakely-Gray 2021).

Postpartum Coverage Period*: State has expanded the Medicaid coverage period beyond the typical 60 day postpartum period for women who have pregnancy-specific Medicaid eligibility.

Pregnant Immigration Coverage*: State expands coverage to pregnant immigrants who have been in the United States for less than 5 years.

Presumptive Eligibility*: State permits pregnant women who are determined to be eligible for Medicaid by qualified entities to temporarily enroll until the final eligibility is determined.

Education to Providers*: State has initiatives to educate physicians, nurses, health care facilities, etc. about maternal health issues and provides education to identify high-risk women.

Education to Beneficiaries*: State has initiatives to educate pregnant women in Medicaid about maternal health issues.

Outreach to beneficiaries or prospective beneficiaries*: State contacts all pregnant women for maternal care services for additional support (non-education related).

Peer supports*: State provides peer support programs for pregnant women in Medicaid who are not part of group prenatal care.

Monetary incentives*: State provides incentives to pregnant women for attending visits or completing tasks. Incentives could include payments or goods such as diapers or formula.

Doula care*: State covers doulas, a trained companion who is not a healthcare professional and who supports another individual through a significant health-related experience, and other continuous labor support providers.

Substance use disorder treatment*: State covers substance use disorder treatment for pregnant women.

Mental health treatment*: State covers mental health treatment for pregnant women.

Postpartum depression screening*: State covers postpartum depression screening for mothers under the infant’s Medicaid ID.

Pregnancy medical homes*: State has a pregnancy/maternal medical home program.

Group prenatal care*: State has programs that provide prenatal care in group settings.

*This data was retrieved from a report that was made under contract to the Medicaid and CHIP Payment and Access Commission (MACPAC) (Mathematica 2019-2020).

Part 2: Infant Mortality

Additionally, we ran two linear regression tests, one to test the relationship between healthcare coverage and another on infant mortality. We hypothesized that states with lower rates of coverage would have higher rates of both infant and maternal mortality. For both tests, we used data from the 2019 Census. The Census provides information for the percentage of people in each state who were uninsured at the time of data collection. For infant mortality data, we used data from the CDC which tracks infant mortality. The CDC defines infant mortality as the death of a child under 1 year of age. For a holistic analysis, we investigated infant mortality as a whole and did not specify infant mortality based on race, location, health or mother, risk factors, or labor/delivery characteristics. Results of the linear regression test are in Figure 2.

Results

Part 1: Maternal Healthcare Services

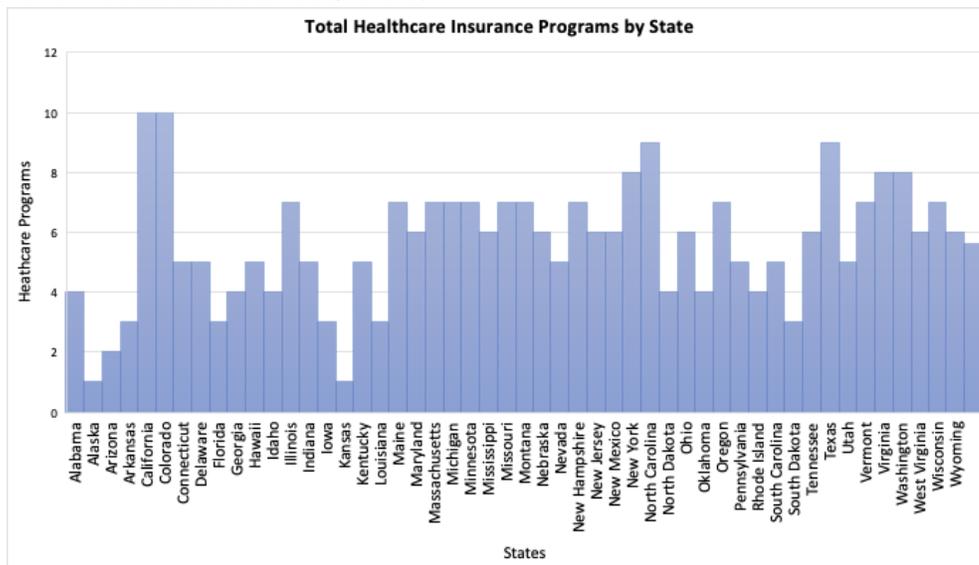


Figure 1. Sum of maternal healthcare services by state

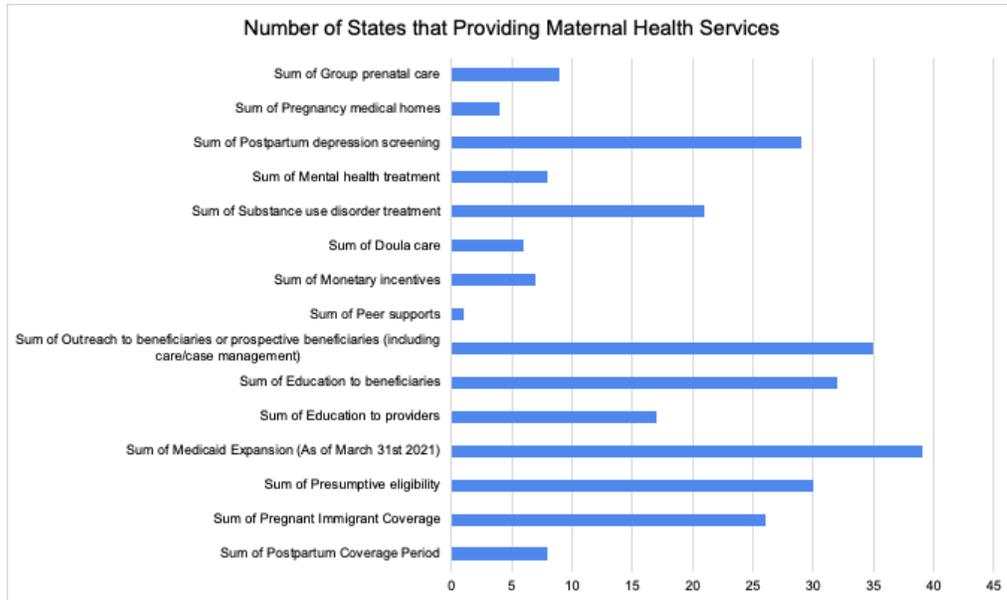


Figure 2: Number of States that Providing Maternal Health Services

Part 2: Regression

Linear Regression

Model Summary – Infant mortality rate

Model	R	R ²	Adjusted R ²	RMSE
H ₀	0.000	0.000	0.000	1.084
H ₁	0.296	0.088	0.069	1.046

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
H ₁	Regression	5.039	1	5.039	4.606	0.037
	Residual	52.508	48	1.094		
	Total	57.546	49			

Note. The intercept model is omitted, as no meaningful information can be shown.

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
H ₀	(Intercept)	5.850	0.153		38.169	< .001
H ₁	(Intercept)	4.995	0.425		11.760	< .001
	V2019 uninsured	0.102	0.048	0.296		

Figure 3. Results for linear regression test of effect healthcare coverage on infant mortality.

Linear Regression ▼

Model Summary – Maternal Mortality

Model	R	R ²	Adjusted R ²	RMSE
H ₀	0.000	0.000	0.000	10.748
H ₁	0.391	0.153	0.134	10.002

ANOVA ▼

Model		Sum of Squares	df	Mean Square	F	p
H ₁	Regression	812.388	1	812.388	8.120	0.007
	Residual	4501.881	45	100.042		
	Total	5314.269	46			

Note. The intercept model is omitted, as no meaningful information can be shown.

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
H ₀	(Intercept)	21.974	1.568		14.016	< .001
H ₁	(Intercept)	10.129	4.405		2.299	0.026
	V2019 uninsured no DC	1.366	0.479	0.391	2.850	0.007

Figure 4. Results for linear regression test of effect healthcare coverage on maternal mortality.

Discussion

We see that while most states contain more than four different kinds of maternal healthcare services, a majority of those services are centered around education rather than action. Superficially many states look like they're making progress in terms of maternal health care access, while 74 percent of states have Medicaid expansion there is still a large discrepancy in maternal mortality rates. The implementation of these programs has yet to affect the quality of healthcare. This could be attributed to the fact that many of the programs adopted in Figure 1 favored expansion on eligibility and postpartum depression screening over practical support such as mental health treatment or Doula care.

Eligibility and screening can assist in overall access but do not guarantee medical assistance nor treatment. The lack of support for services that provide active care, such as Doula coverage, stunts practical change. Programs that provide services pre and post-pregnancy are essential to supporting mothers. The lack of public health care leaves low-income women at a great disadvantage. Many low-income women need additional support postpartum yet can not afford additional support. In contrast, high-income women have greater access to healthcare and the

ability to afford additional healthcare services. This is supported by our linear regression test for the impact of healthcare access on infant mortality. Our results suggest there is a positive correlation between higher rates of uninsurance and higher rates of infant mortality ($p < 0.037$). Looking at these economic factors and the general racial makeup of citizens with a low socio-economic health economic state in the US black mothers are at a clear disadvantage.

Geographically, we clearly identify four leading states, California, Colorado, North Carolina, and Texas. California's placement is expected considering its history with maternal healthcare. California has seen a decline in maternal mortality by 55 percent between 2006 to 2013 in comparison to the steady increase of maternal mortality on a national scale (State of California, Department of Public Health). But the additional states in comparison have much lower mortality rates, this signals that there is no direct correlation between the number of programs and the rate of maternal mortality.

Limitations and Further Study

The solutions that we identified may be too generic to apply on a state or local level considering that every state has a different level of progress when it comes to decreasing maternal mortality rates. Also, in the Maternal Healthcare Services part of our study, we only looked at certain insurance-related programs that each state offered. Some states have implemented various other programs at the state level and local level that this study does not consider. Contrarily, many states have not already established the groundwork to lower maternal mortality, so our solutions may not apply to these states.

Additionally, referring back to the maternal health programs that each state provides, our study did not focus on how some programs may have a more significant impact than others. Some services might have a more profound effect than others. This limits the scope of our study because the total points of one state may represent services that are not as valuable as the services another state offers even if they have the same total score. Our assessment of maternal mortality may also be slightly inconsistent with other similar studies considering that some maternal mortality data reporting centers consider pregnancy-related deaths of mothers up to 60 days after labor to qualify as maternal mortality cases. The data we used may not cover all of the cases considered as pregnancy-related deaths by other sources because our datasets only contain data that follows our definition of maternal mortality that is limited to 42 days after labor.

The biggest limitation of our study was the limited time range that we were able to retrieve maternal mortality rates data from. Years before 2003, specifically in the United States, research tended to underestimate the amount of maternal mortality. Between the years of 2007 and 2018, there was an overall stop in reporting by the CDC due to the lack of accurate interpretation of maternal mortality. In mid-2017 all states implemented a checkbox item to their death certificate asking whether the decedent was pregnant or recently pregnant. 2018 was the first year in which a checkbox indicated if this was implemented (Hoyert & Miniño 2020).

To expand on our research, studies could be done to investigate maternal mortality under a new context. Further studies could be done to analyze the relationship between illegal and unsafe

abortion procedures and maternal mortality. Certain states are passing stricter abortion laws, which may cause an increase in maternal mortality rates (World Population Review 2021). The conditions of hospitals and how they may contribute to the death of these mothers is another under-researched area. California, a state that has been successful in lowering the amount of maternal mortality in their state in recent years, could be used as an exemplar for other states that are lagging behind. The feasibility of expanding California's efforts on a national level would make for an impactful research study. Research on the improvements in data collections needed to standardize the reporting of maternal mortality cases and rates would close the gap in maternal mortality reporting. Lastly, further studies should be done to find possible solutions to decrease maternal mortality within minority communities in rural areas. This study should analyze how both geographic location and race are factors that are highly influential in the prevalence of maternal mortality in the United States, and internationally.

The most efficient way to prevent these high maternal mortality rates is through potential solutions such as preventing unwanted pregnancies with equitable access to contraception, safe abortion services to the full extent of the law, and essential, quality post-abortion care. In order to eliminate the racial disparities in maternal mortality, it is important to address the need for improved access to critical service through training and strengthening already existing health programs. One example would be offering African American women tools to navigate the healthcare system and be screened and treated for the risk of preterm birth. Another way to look about this is training providers to address racism and build a more diverse healthcare force by dismantling care barriers. It is crucial that the healthcare system ensure equity for this whole process.

With the United States maternal mortality rates rising steadily over the past two decades, it is imperative that the federal government, state governments, hospitals, and all healthcare workers implement changes in the maternal healthcare system. Through our research, we have pinpointed the areas of underperformance in maternal healthcare, identified certain demographics that have historically been underserved, and provided solutions that can help decrease the maternal mortality rates and reduce the racial disparity. Further, it will take each state's cooperation to increase both the reach of maternal health programs and the accuracy of maternal mortality rate reporting in order to tackle this issue on a nationwide level. We would like to thank all of the authors of the papers we have cited and any researchers, healthcare workers, or policymakers who are working on decreasing maternal mortality rates.

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