A Data-Driven Approach to Political and Health Indicators on Maternal Mortality

Elisha Clark[a,b], **Sarah Mathey**[a,b], **and Kaitlyn Vana**[a,b]

This manuscript was compiled on December 17, 2024

Since the Dobbs v. Jackson Women's Health Organization decision was handed down by the US Supreme Court in 2022, the effect of access to abortion care on maternal mortality has become an increasingly salient topic. This paper asks whether there is a relationship between political indicators and maternal mortality rates when controlling for other predictive factors such as health indicator data. Moreover, we make the case for the necessity of continuing to collect accurate data on the issue to improve and expand this research. Through several specifications using OLS regressions, data sources ranging from estimate type data sets for maternal mortality, political indexes on abortion restrictions and state governments, as well as maternal health indicators, we found there was a positive correlation of at least 0.42 more deaths per 100K, even when controlling for other possible indicators of maternal mortality risk. The same result was obtained for the increasing level of abortion restriction- the stricter a state's abortion policies, the higher the rate of maternal mortality at the county-level when controlling for other maternal mortality indicators (an increase of 1.02 deaths in the "Most Restrictive" category).

Maternal Mortality - trends | Health and Political Indicators | Abortion Policy | Politics and Maternal Mortality

Significance Statement

Collecting maternal mortality data is crucial for policy analysts and researchers, but its is doubly important that this data be organized, accessible, and accurate. In a post-Dobbs decision environment, data now exists from a pre- and post-Roe time period, by which the actual health and societal effects of abortion access can be measured in a way that historically has not been possible.

Abortion laws have changed with remarkable speed in the past decade compared to when they first reached the high court with the decision of Roe v. Wade. Leading up to the landmark decision being struck down in the summer of 2022, states across the country were already passing more stringent abortion laws, affecting access to abortion-related healthcare. Challenges exist in this area of study in terms of availability of data, due to both privacy concerns and variations in state data practices, placing limitations on conclusions that can be drawn about patterns in states with tighter abortion restrictions or anti-abortion state leadership.

Adding to Existing Research

State abortion policies have been known to affect maternal mortality. A study published in the American Public Health Association outlines this relationship, concluding that restricting access to abortion care at the state level may increase the risk of maternal mortality.[*]

A more grim study explored the relationship between state-level variations in mortality among young children and state abortion restriction policies, concluding that stricter policies were associated with an average increase of 5.7 deaths per state.[†]

[*] Dovile Vilda, Maeve E. Wallace, Clare Daniel, Melissa Goldin Evans, Charles Stoecker, Katherine P. Theall, "State Abortion Policies and Maternal Death in the United States, 2015–2018", American Journal of Public Health 111, no. 9 (September 1, 2021): pp. 1696-1704

[†] Bisakha Sen, Martha Slay Wingate, and Russell Kirby, "The Relationship Between State Abortion-Restrictions and Homicide Deaths Among Children Under 5 Years of Age: A Longitudinal Study," Social Science and Medicine 75, no. 1 (July 2012): 156–64, https://doi.org/10.1016/j.socscimed.2012.01.037.

Author affiliations: [a]Georgetown University; [b]McCourt School for Public Policy

The implications of these results not only illustrate how important these findings are to maternal health, but also the health and well-being of children.

The Effect of Government, Abortion Protections, and Restrictions. Ten states had abortion measures on the ballot in 2024. Seven of those states adopted protections for abortion rights, six of which were implemented immediately (Nevada is required to vote twice to pass ballot measures, and therefore will vote again in 2026), and the remaining three did not pass abortion protections or passed complete bans.[‡]

The effects of abortion bans are seemingly well-known. Our goal was to generate a dataset that could be easily replicated and expanded for future research in order to analyze the effects of restrictive state abortion policies. We in turn used this data to assess the relationship between political indicators of maternal mortality, controlling for other predictive factors, specifically health indicator data.

Our Findings. When examining the relationship between maternal mortality rate and residence in a GOP controlled state, we found that there was a positive correlation of at least 0.42 more deaths per 100K at the county level, even when correcting for other possible indicators of maternal mortality risk. The same result was obtained for the increasing level of abortion restriction- the stricter a state's abortion policies, the higher the rate of maternal mortality at the county level when controlling for other maternal mortality indicators (an increase of 1.02 deaths in the "Most Restrictive" category). Certain limitations must be carefully considered when interpreting this data, as many factors such as economic disparities, maternal age, characterization of the pregnancy (wanted, unwanted), were not included in the analysis but can be reasonably assumed to affect maternal mortality rates and the impacts of restrictive abortion policies.

Data and Methods

Data Sources and Documentation. **Maternal Mortality.** We acquired the data set for estimated maternal mortality and demographics from the Global Health Data Exchange (GHDx) data catalog, coordinated by the University of Washington's Institute for Health Metrics and Evaluation (IHME). This dataset provides estimated maternal mortality rates at the county level across multiple years.[§]

---

‡ Erin Geiger Smith and Kathrina Szymborski Wolfkot, "Voters in Seven States Pass Measures to Protect Abortion," State Court Report, November 6, 2024, https://statecourtreport.org/our-work/analysis-opinion/voters-seven-states-pass-measures-protect-abortion.

§ Institute for Health Metrics and Evaluation, "Causes of Death (COD) Visualization," updated April 3, 2024,https://vizhub.healthdata.org/cod/.

Maternal Health Indicators. We acquired our data set for maternal health indicators from the Health Resources and Services Administration's (HRSA) Maternal and Infant Health Mapping (MIHM) Tool.[¶] HRSA's MIHM Tool explores a diverse range of maternal and infant population information and health resources indexed by county FIPS codes. We included the following health indicators, all of which were cataloged as incidence per 100K births: prenatal care in the first trimester, diabetes pre-pregnancy, hypertension pre-pregnancy, and obesity pre-pregnancy.

Abortion Restrictions/Protections Index. We acquired our data set for state abortion laws from the Guttmacher Institute's Interactive Map, which groups states according to seven categories.[‖] The data set is current as of November 26, 2024.

State Government. Finally, our data set for state legislature party control was scraped from Ballotpedia and filtered to the year 2017 to allow for a lagged comparison of party control and resulting health outcomes, indexed by state.[**] The data for the state governor party came from Wikipedia for the year 2017. Since these data sets reflected election results, we indicated party control began the year following the election year, not the election year itself.

Limitations Among Chosen Datasets. The primary limitation of our data is the necessity to rely on estimated data given the inconsistency in measurement and availability of health data. We also note that our data does not span across a consistent time period with maternal mortality rates estimated for 2019 and our health indicator covariates ranging across three years (2017-2020). We pull from enough sources and include enough overlapping and adjacent indicators that this is not a large concern for our project.

Generally, medical conditions, such as diabetes and hypertension, are likely under-reported, and availability and accuracy depends on geographic location. HRSA notes the degree of smoothing is inversely proportional to the number of events, borrowing from data in neighboring counties, to ensure usable data, and estimates were suppressed if there were fewer than 10 events in the county and adjacent counties[††]. HRSA worked in agreement with some counties directly, but cannot disclose which counties specifically due to confidentiality. This is the nature of health data that is not collected from a primary resource.

Additionally, there may be measurement error in terms of how pregnancy related deaths are recorded. A study by the American

[¶] U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA). "Maternal and Child Health Bureau Interactive Map Tool." https://data.hrsa.gov/maps/mchb.

[‖] Guttmacher Institute, "Interactive Map: US Abortion Policies and Access After Roe," https://states.guttmacher.org/policies/.

[**] Ballotpedia, "Main Page," https://ballotpedia.org/Main$_{page}$.

[††] Data downloaded from the Maternal and Infant Health Mapping Tool, a website developed by the Health Resources and Services Administration, Maternal and Child Health Bureau. https://data.hrsa.gov/maps/mchb/. Accessed Dec 2024.

DATA AND METHODS

Maternal Health Indicators	- U.S. Department of Health and Human Services, Health Resources and Services Administration (**HRSA**). "Maternal and Child Health Bureau Interactive Map Tool." - Indexed by county **FIPS** codes (and thus HRSA region, state, and county name)
Abortion Restrictions	- **Guttmacher Institute**, "Interactive Map: US Abortion Policies and Access After Roe," current as of Nov 26, 2024 - Indexed by **state**
Maternal Mortality	- University of Washington's Institute for Health Metrics and Evaluation (**IHME**), "Causes of Death (COD) Visualization," updated April 3, 2024 - Indexed by **year**
State Government	- Scraped from Ballotpedia - Indexed by **state**

Fig. 1. Data Sources and Indexes

Journal of Obstetrics and Gynecology suggests that rising rates between 2018 and 2021 can partially be attributed to changes in maternal mortality surveillance. In 2002, a "pregnancy-related death" checkbox was added on the national death certificate. The study found that this checkbox was unreliable, including deaths of male patients or female patients who were not even pregnant. This led to an over-inflated figure for data collected from 2002-2018.[‡‡] Assuming these errors are evenly distributed, we assess the risk of the error creating significant bias is low.

Variables and Covariates. **Maternal Mortality (dependent variable)**: The maternal mortality rate in this dataset is reported as a fraction of live births. To interpret the rates in the standard unit of deaths per 100,000 live births, values must be multiplied by 100,000

Guttmacher Index (independent variable): Dummy variables based on state's level of restriction/protection are as follows: - Most Restrictive - Very Restrictive - Restrictive - Some Restrictions/Protections - Protective - Very Protective - Most Protective

GOP Trifecta (independent variable): dummy variable indicating a Republican controlled state legislature and executive branch.

Health Indicators (covariates): certain indicators of overall health in the population to control for other factors that may

[‡‡] Jane Smith, "Maternal Mortality Overestimate: Deaths, Births, Health Disparities," NPR, March 13, 2024, https://www.npr.org/sections/health-shots/2024/03/13/1238269753/maternal-mortality-overestimate-deaths-births-health-disparities.

increase risk of mortality. - OBGYN Provider Rate - providers per 100K - Prenatal Care First Trimester - Percentage - Obesity Pre-Pregnancy - Percentage - Diabetes Pre-Pregnancy - Percentage - Hypertension Pre-Pregnancy - Percentage

Data Wrangling. All data required some level of cleaning, whether it was standardizing column names or ensuring the county-level data was able to be matched with other sources.

Maternal Mortality (maternal_mortality_county_data_wrangling.ipynb) Maternal Mortality was provided at national, state and county levels and had observations for various racial and ethnic groups over multiple years. The entire data set was split into multiple files to manage the file size. The first steps were to combine all the files and filter the resulting data frame to only county-level rows. Because Louisiana and Alaska both use different geographical regions, Parishes and Boroughs, respectively, initially, we accidentally filtered both states out of our data set and had to readjust our code. Since the original data set included data across multiple years and broken down by race, we filtered the data set to 2019, and to observations that reflected the total values across all races. We also extracted the state name from the location column to help us join this dataset to state-level datasets.

Guttmacher Index (project_political_data - Center_for_repro_rights.csv) The Guttmacher index was provided at the state level. This index examines a range of policies relating to abortion, selecting approximately 20 types of abortion restrictions and 10 protective policies. These include, but are not limited to, gestational duration bans, waiting periods, insurance coverage bans, and medication abortion restrictions, state constitutional protections, abortion funding, insurance coverage for abortion, and protections for patients and clinic staff. The states are then assigned to one of the seven categories previously mentioned based on the policies currently in effect (as of November 2024).[§§]

GOP Trifecta (ballotpedia_state_leg_scraper.ipynb) GOP trifecta was provided on the state level. This dataset used election results data scraped from ballotpedia (for state legislative races), and gathered from Wikipedia (for gubernatorial races) to determine whether each state had a Republican government trifecta in a given year.

Because these data sources reflected election results and not governing control, we took the election results data and used a lagged variable based on election year to code the years following the election year as having had that party controlling the respective office. Next, using a fact table of years*state as our base table, we used the *pandasql* package to employ a SQL query so that we

[§§] Guttmacher Institute. "Methodology: State Policies in Brief." https://states.guttmacher.org/policies/methodology.html.

could do a range join over years and state. This, together with the election year lag variable, allowed us to fill in the years between elections with data on party control.

Health Indicators Each health indicator was downloadable as a CSV file from HRSA, and each of these was combined using a python script that cleaned and organized the data. Health indicators were provided at the county level.

When merging the data, some data sets had variables for full state name and some used state abbreviations. To address this we also joined a small states data set from a csv to make the connection between state name and abbreviation where needed.

Analysis

We based our specifications on two theories:

1. Having a GOP trifecta in a state will increase maternal mortality rates, other things equal
2. More restrictive abortion policies will increase maternal mortality rates, other things equal

To test these theories, we ran regressions using Ordinary Least Squares (OLS).

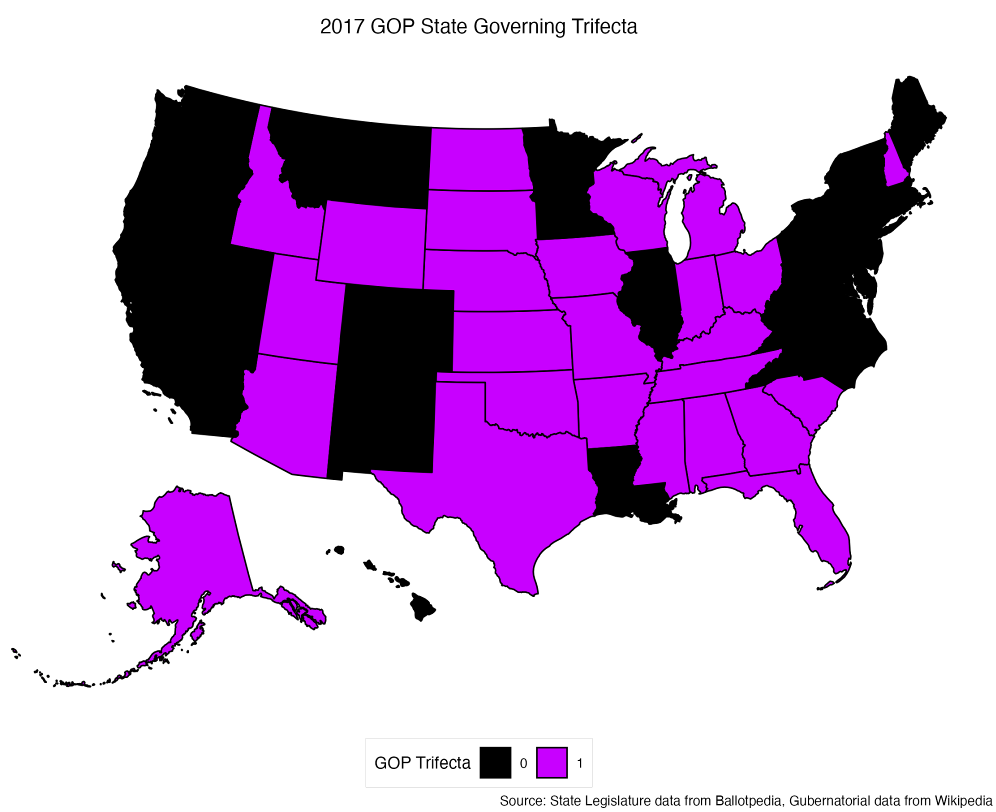

Fig. 2. GOP Trifecta

GOP Trifecta. We tested our first theory on the impact of having a GOP trifecta at the state level using three specifications. First, we ran a regression with the effect of a GOP trifecta on maternal mortality rate. Next, we show standardized Maternal Mortality Rate (MMR) for easier interpretability, which was used for all subsequent measures of maternal mortality. Finally, we add health indicator covariates.

For our first theory and specification, we estimate the following Ordinary Least Squares (OLS) regression model to assess the relationship between maternal mortality rate

(y) and the GOP trifecta variable (X):

$$y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

Where:

- y_i is the maternal mortality rate (MMR rate) for observation i,
- X_i is the GOP trifecta variable for observation i,
- β_0 is the intercept (constant),
- β_1 is the coefficient for the GOP trifecta variable,
- ϵ_i is the error term for observation i.

We add a constant term to the GOP trifecta variable matrix X before fitting the model: X = sm.add_constant(X)

The model is then fitted using OLS, and the estimated coefficients are computed:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 X$$

Where $\hat{y}$ is the predicted maternal mortality rate, and $\hat{\beta}_0$ and $\hat{\beta}_1$ are the estimated coefficients from the regression.

For our first theory, second specification, we first standardize the Maternal Mortality Rate (MMR) by subtracting the mean of MMR and dividing by the standard deviation.

Next, we estimate the following Ordinary Least Squares (OLS) regression model to assess the effect of a GOP trifecta on the standardized MMR and add a constant to the GOP trifecta variable matrix X before fitting the model: X = sm.add_constant(X) The model is then fitted using OLS, and the estimated coefficients are computed as:

$$\hat{\text{MMR}}_{\text{standardized}} = \hat{\beta}_0 + \hat{\beta}_1 \, \text{GOP\_Trifecta}$$

Where $\hat{\text{MMR}}_{\text{standardized}}$ represents the predicted standardized maternal mortality rate, and $\hat{\beta}_0$ and $\hat{\beta}_1$ are the estimated coefficients from the regression. Additionally, one standard deviation of MMR on the original scale corresponds to a value of:

$$\text{Deaths per 100,000} = \sigma_{\text{MMR}} \times 100,000$$

In the third specification, we control for various health indicators in addition to the GOP trifecta.

The covariates X include the GOP trifecta variable and several health indicators, which, to reiterate, are:

- $GOP\_Trifecta$
- $Obgyn\_Provider\_Rate\_100k$
- $Prenatal\_Care\_First\_Trimester\_Pct$
- $Obesity\_Pre\_Pregnancy\_Pct$
- $Diabetes\_Pre\_Pregnancy\_Pct$
- $Hypertension\_Pre\_Pregnancy\_Pct$

The full model, including an intercept β_0, is specified with the constant as

$$\begin{aligned}\hat{\text{MMR}}_{\text{standardized}} = {} & \hat{\beta}_0 + \hat{\beta}_1 \text{ GOP\_Trifecta} + \hat{\beta}_2 \text{ Obgyn\_Provider\_Rate\_100k} + \\ & \hat{\beta}_3 \text{ Prenatal\_Care\_First\_Trimester\_Pct} + \hat{\beta}_4 \text{ Obesity\_Pre\_Pregnancy\_Pct} + \\ & \hat{\beta}_5 \text{ Diabetes\_Pre\_Pregnancy\_Pct} + \hat{\beta}_6 \text{ Hypertension\_Pre\_Pregnancy\_Pct}\end{aligned}$$

Where $\hat{\text{MMR}}_{\text{standardized}}$ is the predicted standardized maternal mortality rate, and $\hat{\beta}_0, \hat{\beta}_1, \ldots, \hat{\beta}_6$ are the estimated coefficients from the regression. The results are shown in Fig. 4.

Guttmacher Index. As we did with GOP trifecta theory, we tested our theory on the impact of abortion policies using three specifications. The first one looked at the comparative effect of states with the highest level of abortion restriction compared to the states most protective on maternal mortality rates. Next, we include a specification for all levels of abortion restriction that the index captures, providing a coefficient for each index. Finally, we looked again at the effect of all levels of abortion restriction on maternal mortality, this time controlling for health indicators.

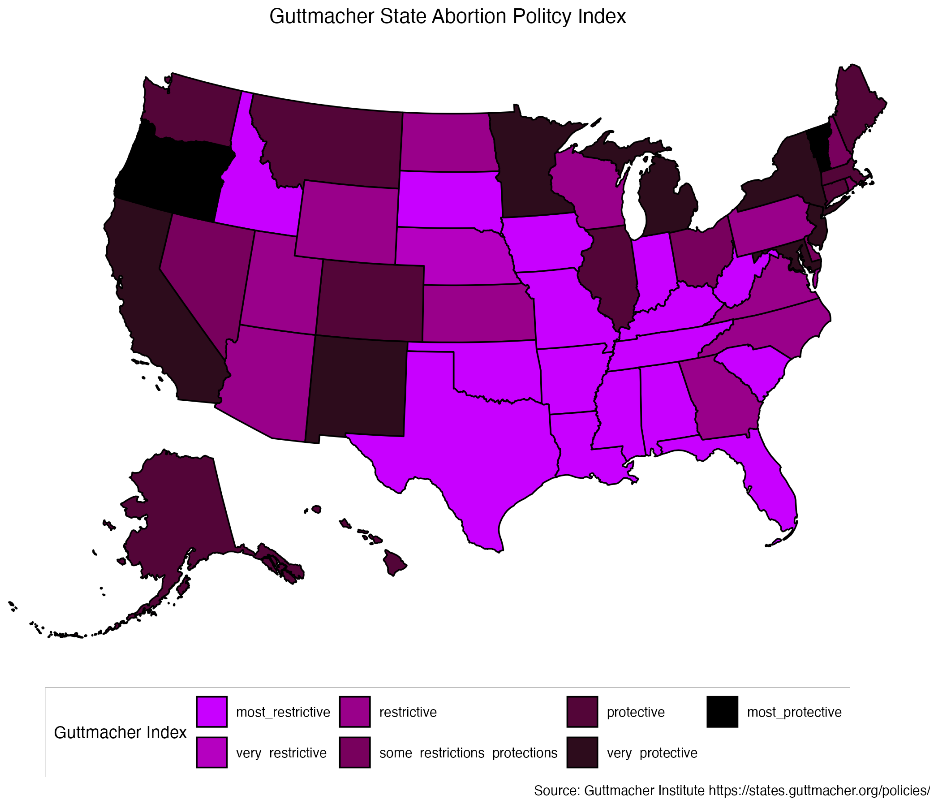

Fig. 3. Guttmacher Index

To handle missing values in the dataset, NA values were handled through column-wise operations to include as many observations as possible. All 50 states were represented, with states like Alaska and Louisiana retrofitted to conform with "county" columns (Alaska has "boroughs" and Louisiana has "parishes"). The resulting dataset produced 2,975 observations, encompassing 95 percent of the 3,144 counties in the Continental United States. Checks were performed to ensure the same number of observations were included in each regression.

For our second theory involving the Guttmacher Index, we examine the effect of abortion policy restrictions, specifically the Guttmacher "most restrictive" category, on standardized maternal mortality. The regression model we estimate is:

$$y_i = \beta_0 + \beta_1 \cdot \text{Guttmacher\_Most\_Restrictive}_i + \epsilon_i$$

Where:

- y_i is the standardized maternal mortality rate for state i.
- β_0 is the intercept.
- β_1 is the coefficient for the Guttmacher "most restrictive" indicator.

- ϵ_i is the error term.

We estimate this model using Ordinary Least Squares (OLS).

For the second specification, we included all levels of abortion restrictions as explanatory variables. The model can be represented as:

$$\text{MMR}_i = \beta_0 + \beta_1 \cdot \text{Guttmacher}_{\text{most restrictive},i} + \beta_2 \cdot \text{Guttmacher}_{\text{very restrictive},i} +$$
$$\beta_3 \cdot \text{Guttmacher}_{\text{restrictive},i} + \beta_4 \cdot \text{Guttmacher}_{\text{some restrictions protections},i} +$$
$$\beta_5 \cdot \text{Guttmacher}_{\text{very protective},i} + \beta_6 \cdot \text{Guttmacher}_{\text{protective},i} + \epsilon_i$$

Where:

- MMR_i is the standardized maternal mortality rate for state i,
- $\text{Guttmacher}_{\text{most restrictive},i}$, $\text{Guttmacher}_{\text{very restrictive},i}$, $\text{Guttmacher}_{\text{restrictive},i}$, $\text{Guttmacher}_{\text{some restrictions protections},i}$, $\text{Guttmacher}_{\text{very protective},i}$, and $\text{Guttmacher}_{\text{protective},i}$ are dummy variables representing various levels of abortion restrictions in state i,
- β_0 is the intercept, and
- ϵ_i is the error term.

For our final and most comprehensive specification, we include all levels of abortion restrictions and health indicators as explanatory variables. The model can be represented as:

$$\text{MMR}_i = \beta_0 + \beta_1 \cdot \text{Guttmacher}_{\text{most restrictive},i} + \beta_2 \cdot \text{Guttmacher}_{\text{very restrictive},i} +$$
$$\beta_3 \cdot \text{Guttmacher}_{\text{restrictive},i} + \beta_4 \cdot \text{Guttmacher}_{\text{some restrictions protections},i} + \beta_5 \cdot \text{Guttmacher}_{\text{protective},i} +$$
$$\beta_6 \cdot \text{Guttmacher}_{\text{very protective},i} + \beta_7 \cdot \text{ObGyn Provider Rate}_i + \beta_8 \cdot \text{Prenatal Care (First Trimester)}_i +$$
$$\beta_9 \cdot \text{Obesity Pre-Pregnancy}_i + \beta_{10} \cdot \text{Diabetes Pre-Pregnancy}_i + \beta_{11} \cdot \text{Hypertension Pre-Pregnancy}_i + \epsilon_i$$

Where:

- MMR_i is the standardized maternal mortality rate for state i,
- $\text{Guttmacher}_{\text{most restrictive},i}$, $\text{Guttmacher}_{\text{very restrictive},i}$, $\text{Guttmacher}_{\text{restrictive},i}$, $\text{Guttmacher}_{\text{some restrictions protections},i}$, $\text{Guttmacher}_{\text{protective},i}$, and $\text{Guttmacher}_{\text{very protective},i}$ are dummy variables representing various levels of abortion restrictions in state i,

- ObGyn Provider Rate$_i$ is the number of ob/gyn providers per 100,000 population in state i,
- Prenatal Care (First Trimester)$_i$ is the percentage of prenatal care initiated in the first trimester in state i,
- Obesity Pre-Pregnancy$_i$, Diabetes Pre-Pregnancy$_i$, and Hypertension Pre-Pregnancy$_i$ are the respective health indicators for state i,
- β_0 is the intercept, and
- ϵ_i is the error term.

Standardization of MMR. In order to improve readability of our coefficients, the regression was run on standard deviation of the maternal mortality rate column in our dataset. This was calculated using the z-score formula in pandas, with the raw MMR value subtracted from the mean of the MMR column and then dividing that result by the standard deviation of the column. In the interpretation of our data, a standard deviation equals roughly 1.36 deaths per 100K maternal deaths, therefore coefficients can be multiplied by this factor when interpreting results.

Results. Our regression results for GOP Trifectas are shown in the following figures:

Theory One: A GOP trifecta has a positive relationship with maternal mortality.

	(1)	(2)	(3)
const	0.000^{***}	-0.350^{***}	0.758^{***}
	(0.000)	(0.030)	(0.205)
diabetes_pre_pregnancy_pct			-0.192^{***}
			(0.037)
gop_trifecta	0.000^{***}	0.533^{***}	0.316^{***}
	(0.000)	(0.037)	(0.029)
hypertension_pre_pregnancy_pct			0.279^{***}
			(0.015)
obesity_pre_pregnancy_pct			0.068^{***}
			(0.003)
obgyn_provider_rate_100k			0.013^{***}
			(0.001)
prenatal_care_first_trimester_pct			-0.049^{***}
			(0.002)
Observations	2975	2975	2975
R^2	0.064	0.064	0.468
Adjusted R^2	0.064	0.064	0.467
Residual Std. Error	0.000 (df=2973)	0.968 (df=2973)	0.730 (df=2968)
F Statistic	203.159^{***} (df=1; 2973)	203.159^{***} (df=1; 2973)	434.932^{***} (df=6; 2968)
Note:			*p<0.1; **p<0.05; ***p<0.01

Fig. 4. Theory One

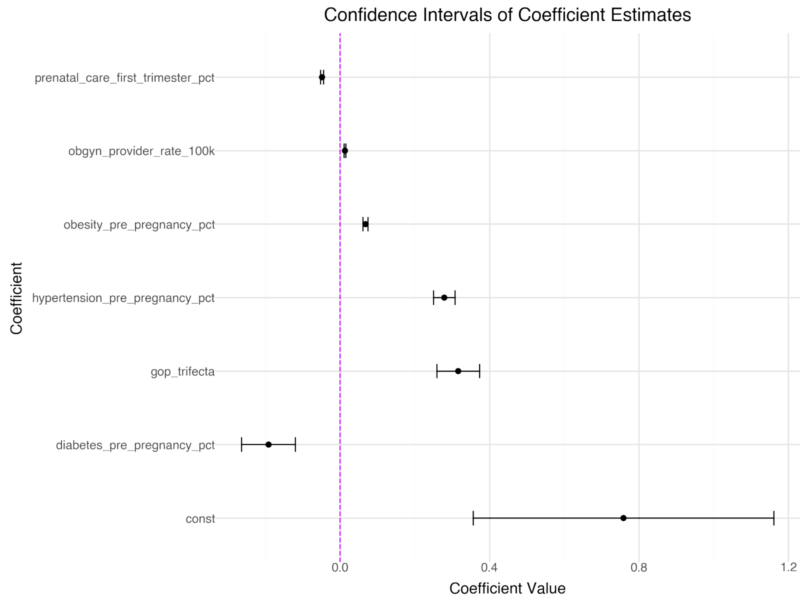

Fig. 5. Theory One Confidence Intervals

The Effect of a GOP Trifecta on MMR. Holding everything else constant, the presence of a GOP Trifecta seems to have a positive relationship with maternal mortality rates in a given state. All coefficients were statistically significant. The magnitude of the actual coefficient, as previously mentioned, is extremely small, making the case that a standardized variable will improve interpretability.

The Effect of a GOP Trifecta on MMR (standardized). After standardizing the maternal mortality figure, our model indicates that having a GOP trifecta is associated with an increase of 0.533 standard deviations in MMR (about a 0.71 increase in deaths per 100K). All coefficients were statistically significant.

The Effect of a GOP Trifecta on MMR with added covariates (health indicators). Continuing to use the standardized maternal mortality rates, we found in this specification that GOP Trifecta continue to be positively correlated with maternal mortality, to a lesser degree. The presence of a GOP Trifecta continues to have more influence than other covariates. OBGYN Provider Rate and Prenatal Care Percentage had a small negative effect on Maternal Mortality, suggesting that access to healthcare reduces the overall rate of maternal death, in keeping with conventional wisdom. A result worth noting was the coefficient associated with Pre-Pregnancy Diabetes, which appeared to suggest that higher diabetes rates are associated with a lower MMR. Pre-Pregnancy Hypertension provided a strong positive association with MMR, influencing maternal death rates almost as much as a GOP Trifecta.

Our results for the Guttmacher Index regressions are as follows:

Theory Two: The highest level of abortion restriction corresponds with the highest level of maternal mortality in a state

		Dependent variable: standardized_mmr	
	(1)	(2)	(3)
const	-0.249***	-1.062***	0.327
	(0.024)	(0.131)	(0.235)
diabetes_pre_pregnancy_pct			-0.208***
			(0.037)
guttmacher_most_restrictive	0.534***	1.348***	0.786***
	(0.035)	(0.133)	(0.106)
guttmacher_protective		0.533***	0.496***
		(0.141)	(0.111)
guttmacher_restrictive		1.214***	0.876***
		(0.136)	(0.107)
guttmacher_some_restrictions_protections		0.782***	0.421***
		(0.156)	(0.122)
guttmacher_very_protective		0.446***	0.384***
		(0.140)	(0.109)
guttmacher_very_restrictive		0.663***	0.821***
		(0.173)	(0.136)
hypertension_pre_pregnancy_pct			0.262***
			(0.015)
obesity_pre_pregnancy_pct			0.066***
			(0.003)
obgyn_provider_rate_100k			0.013***
			(0.001)
prenatal_care_first_trimester_pct			-0.048***
			(0.002)
Observations	2975	2975	2975
R^2	0.071	0.144	0.483
Adjusted R^2	0.071	0.142	0.481
Residual Std. Error	0.964 (df=2973)	0.926 (df=2968)	0.721 (df=2963)
F Statistic	227.033*** (df=1; 2973)	83.198*** (df=6; 2968)	251.195*** (df=11; 2963)

Fig. 6. Theory Two

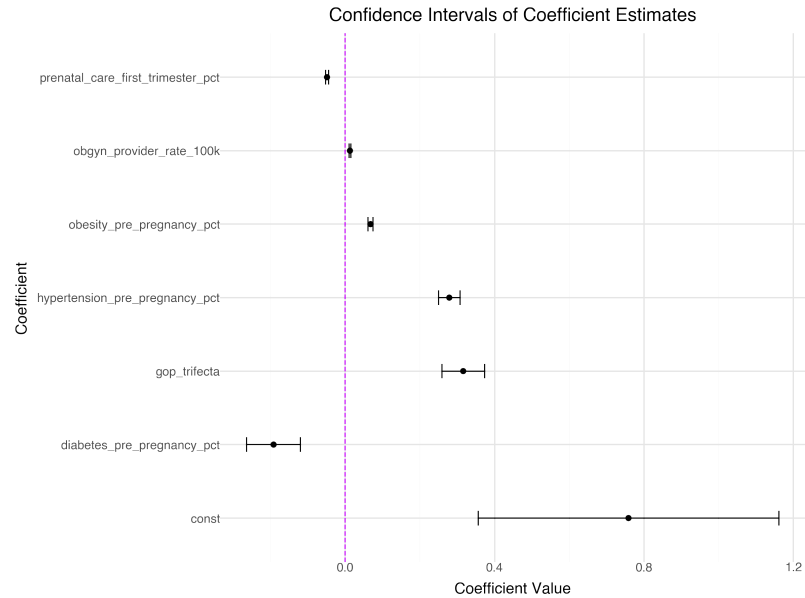

Fig. 7. Theory Two Confidence Intervals

The Effect of Abortion Restriction Level on MMR. When compared to states that had less stringent abortion restrictions, pregnancy in a state with the Most Restrictive category led to a 0.533 standard deviation increase in maternal mortality rates- the exact same value as a GOP trifecta (associated with an increase of 0.71 deaths per 100K). This coefficient is almost identical to the first specification of GOP Trifecta vs. MMR. The intercept was -0.249 (or 0.33 fewer deaths per 100K), which indicates a negative correlation between being in a state that did not fall under the "Most Restrictive" category. This result suggests that policies that restrict abortion are correlated with an increase in maternal mortality. All coefficients were statistically significant.

The Effect of Abortion Restriction Level on MMR (all levels). In this specification, the largest effect came from "Most Restrictive" states, in keeping with results from the first Guttmacher Index regression. Although higher in magnitude in terms of restriction levels, the coefficient for "Very Restrictive" had a much lower effect (0.663) than the coefficient for "Restrictive" (1.213). This result raises questions about the differentiation between categories and possible uncaptured confounding variables. The remainder of the restriction levels are consistent with the hypothesis that higher levels of abortion restriction lead to higher maternal mortality rates.

The Effect of Abortion Restriction Level on MMR (all levels), with added covariates (health indicators). When controlling for health indicators, the general narrative appears to follow the pattern that the more restrictive a state's policies are, the higher the maternal mortality rate is likely to be. Diabetes Pre-Pregnancy continues to suggest, against conventional wisdom, a decrease in MMR. All other covariates behave similarly to the third GOP Trifecta specification.

Discussion

Overall, the presence of a GOP Trifecta and increasing levels of abortion restriction correlated with higher maternal mortality rates, including results calculated after adding health indicator covariates for expectant mothers.

Diabetes Pre-Pregnancy as an Indicator. The unexpected result of diabetes decreasing the incidence of maternal mortality could be associated with the several confounding factors. Among these are access to quality healthcare, under-reporting among populations with lower rates of healthcare access, and interactions with other health indicators. Women with diabetes might receive more frequent and specialized care during pregnancy, such as high-risk monitoring or early screening for complications, potentially mitigating risks associated with diabetes. More likely, the result is due to under-reporting among populations with less healthcare access. Correcting for socioeconomic indicators may improve this result. Interactions with other health indicators are also a possibility. Women with diabetes may be more likely to have blood pressure and obesity issues, which can cause an interaction of the variables and produce unexpected results.

Statistical Insignificance of "Most Protections" Category. This result could potentially be explained by the small number of observations in this category. Only three states were classified as "Most Protections" states. Those included Maryland, Vermont, and Oregon. There were potentially not enough data points for the result to be statistically significant, due to the low number of counties in these states (69 total across all three, meaning only 69 observations).

Implications and Importance of This Dataset and Research. Our most significant goal for this project was to create a holistic dataset based on available data. Any effort to gather health data generates privacy concerns, and while these are valid considerations, a higher volume of more detailed data could bolster efforts to reduce alarming maternal mortality rates. Research continues to show a relationship between maternal mortality and abortion restricting policies. Maternal deaths after Roe v. Wade was passed in 1973 decreased 30-40 percent for people of color.[¶¶] Without important

[¶¶] Kheyfets, Anna, Shubhecchha Dhaurali, Paige Feyock, Farinaz Khan, April Lockley, Brenna Miller, Lauren Cohen, Eimaan Anwar, and Ndidiamaka Amutah-Onukagha. "In 2021, Over 90 Restrictive Abortion Laws Were Passed." Frontiers in Public Health. National Library of Medicine. https://pmc.ncbi.nlm.nih.gov/articles/PMC10728320/.

figures and information such as those provided here, lawmakers will not be fully equipped to make informed policy decisions, nor will voters be as informed.

Several states want to discontinue examining this type of data. Each state has a Maternal Mortality Committee comprised of medical professionals who publish an annual report attempting to determine if any deaths were preventable. Some committees provide recommendations based on demographics. The Texas Maternal Mortality and Morbidity Review Committee announced in November of 2024 that they would not review cases from 2022 and 2023, which are years immediately following the implementation of laws that placed Texas in the "Most Restrictive" Guttmacher Index category.[***] Following suit, Georgia's state public health commissioner dismissed all members of the state's maternal mortality committee, a state that banned abortions after six weeks. In 2023, Idaho's maternal mortality committee was dissolved completely and then re-convened this year, missing an entire year of analysis for deaths post-roe[†††].

Our results show the importance of accurate and organized data. Without the ability to attribute deaths to abortion restrictions, establishing a causal relationship between abortion restrictions and a higher rate of maternal mortality becomes a challenge. With our dataset, we were unable to make the claim that abortion restrictions impact maternal mortality- we were only able to establish that states with higher levels of restrictions and a GOP trifecta correlated with higher maternal mortality rates, taking into account other health indicators. In this context, maternal mortality committees become exceedingly important in determining the causes of death in these cases that were not due to specific health issues. The limitations of our results may be more informative than the results themselves, as it is apparent that there is a gap in data collection.

Future Considerations. Understanding of the relationship between maternal mortality rates and restrictive abortion policies, typically attributed to GOP control, will allow lawmakers to make more informed and nuanced decisions about health-care policy in their states. These decisions are not limited to policies related to elective abortions, but can affect healthcare of mothers who want to have children and miscarry at some point in their pregnancy. When a miscarriage occurs, doctors often perform a DnC, or dilation and curettage, which is categorized as abortion care. An article published in December of 2024 outlines a situation

[***] Kitchener, Caroline. "Texas Committee Won't Examine Maternal Deaths in First Years after Abortion Ban." The Washington Post, November 26, 2024. https://www.washingtonpost.com/investigations/2024/11/26/texas-committee-wont-examine-maternal-deaths-first-years-after-abortion-ban/.

[†††] Corbin, Clark. "Reconstituted Idaho Maternal Mortality Committee Will Release a New Report by Jan. 31." Idaho Capitol Sun, 13 Dec. 2024, www.idahocapitalsun.com/2024/12/13/reconstituted-idaho-maternal-mortality-committee-will-release-a-new-report-by-jan-31/.

in which a female officer in the military nearly lost her life when TRICARE (the military's health insurance) refused to pay for this procedure.[‡‡‡] While this particular case is more likely due to Hyde Amendment restrictions, it illustrates how much of an impact similar policies have on the lives of prospective mothers outside of the military.

Further Analysis. Beyond obtaining more accurate and complete datasets, many more regressions and analyses can be conducted from the data we do have. Accounting for lower income and rural populations could help explain more of the data and refine relationships between independent and dependent variables in our model. Subsetting the data by race could also help clarify the disparities between populations, which are known to exist. A study conducted by researchers in 2023 at Southern Connecticut State University found that black women have a maternal mortality rate of 2.9 times that of White women.[§§§] Addressing these disparities in future analyses is essential in gaining a complete understanding of the issue.

Further Data-Collection. Shifting to gaps in existing data, the impact of COVID-19, incidence of home-births, maternal age, and documentation of wanted vs. unwanted pregnancies are data points of interest that don't exist yet. As with all other health data phenomena, COVID-19 is an anomaly that may be difficult to address without careful consideration. The incidence of home-births and deaths due to COVID itself are factors that could make causal relationships more difficult to establish. Maternal age could be easier to establish a relationship with, however it also could be considered a privacy issue in the quest to obtain it. Another consideration in examining the impact certain policies have on maternal mortality is the number of pregnancies that were wanted vs those that were unwanted. Women who were forced to carry unwanted pregnancies to term due to state restrictions and then die as a result of their pregnancy have a causal link to these policies compared to women who suffer complications due to miscarriages or difficult births. Without sufficient data collected on the sentiment of women's pregnancies, the connection remains anecdotal and ambiguous.

Conclusion

In closing, while there appears to be a correlation between maternal mortality, GOP leadership and restrictive healthcare policies,

[‡‡‡] Edwards, Erin, and Robin Fields. "A Coast Guard Commander Miscarried. She Nearly Died After Being Denied Care." ProPublica, December 13, 2023.https://www.propublica.org/article/elizabeth-nakagawa-miscarriage-military-tricare-abortion-policy

[§§§] Njoku, Anuli, Marian Evans, Lillian Nimo-Sefah, and Jonell Bailey. "Listen to the Whispers before They Become Screams: Addressing Black Maternal Morbidity and Mortality in the United States." Healthcare 11, no. 3 (2023): 438. https://doi.org/10.3390/healthcare11030438.

more research needs to be done to make a robust causal link to maternal mortality rates especially deaths relating to denial of abortion care. The combination of disparate data sources has allowed us to draw this conclusion among others. This analysis requires a more focused approach in data-gathering, especially in states that are characterized as having the "Most-Restrictive" policies. Researchers ought to be provided with the most up-to-date datasets to conduct the research, and lawmakers with the most up-to-date analyses to allow for more informed policy decisions.

References

1. Vilda, D., Wallace, M. E., Daniel, C., Goldin Evans, M., Stoecker, C., Theall, K. P., "State Abortion Policies and Maternal Death in the United States, 2015–2018," *Am. J. Public Health* **111**, 1696–1704 (2021).
2. Sen, B., Wingate, M. S., Kirby, R., "The Relationship Between State Abortion-Restrictions and Homicide Deaths Among Children Under 5 Years of Age: A Longitudinal Study," *Soc. Sci. Med.* **75**, 156–164 (2012). https://doi.org/10.1016/j.socscimed.2012.01.037.
3. Smith, E. G., Wolfkot, K. S., "Voters in Seven States Pass Measures to Protect Abortion," *State Court Report*, Nov 6, 2024. https://statecourtreport.org/our-work/analysis-opinion/voters-seven-states-pass-measures-protect-abortion.
4. U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA), "Maternal and Child Health Bureau Interactive Map Tool," https://data.hrsa.gov/maps/mchb.
5. Guttmacher Institute, "Interactive Map: US Abortion Policies and Access After Roe," https://states.guttmacher.org/policies/.
6. Institute for Health Metrics and Evaluation, "Causes of Death (COD) Visualization," updated Apr 3, 2024. https://vizhub.healthdata.org/cod/.
7. Ballotpedia, "Main Page," https://ballotpedia.org/Main_Page.
8. Smith, J., "Maternal Mortality Overestimate: Deaths, Births, Health Disparities," *NPR*, Mar 13, 2024. https://www.npr.org/sections/health-shots/2024/03/13/1238269753/maternal-mortality-overestimate-deaths-births-health-disparities.
9. Guttmacher Institute, "Methodology: State Policies in Brief," https://states.guttmacher.org/policies/methodology.html.
10. Kheyfets, A., Dhaurali, S., Feyock, P., Khan, F., Lockley, A., Miller, B., Cohen, L., Anwar, E., Amutah-Onukagha, N., "In 2021, Over 90 Restrictive Abortion Laws Were Passed," *Front. Public Health*, Natl. Lib. Med. https://pmc.ncbi.nlm.nih.gov/articles/PMC10728320/.
11. Kitchener, C., "Texas Committee Won't Examine Maternal Deaths in First Years after Abortion Ban," *The Washington Post*, Nov 26, 2024. https://www.washingtonpost.com/investigations/2024/11/26/texas-committee-wont-examine-maternal-deaths-first-years-after-abortion-ban/.
12. Edwards, E., Fields, R., "A Coast Guard Commander Miscarried. She Nearly Died After Being Denied Care," *ProPublica*, Dec 13, 2023. https://www.propublica.org/article/elizabeth-nakagawa-miscarriage-military-tricare-abortion-policy.
13. Njoku, A., Evans, M., Nimo-Sefah, L., Bailey, J., "Listen to the Whispers before They Become Screams: Addressing Black Maternal Morbidity and Mortality in the United States," *Healthcare* **11**, 438 (2023). https://doi.org/10.3390/healthcare11030438.