2024

Impact of state abortion policies on maternal mortality post Dobbs v Jackson

BOSTON UNIVERSITY

ARAM V. CHOBANIAN & EDWARD AVEDISIAN SCHOOL OF MEDICINE

Thesis

IMPACT OF STATE ABORTION POLICIES ON MATERNAL MORTALITY POST DOBBS V JACKSON

by

SHUHUI JOYCE McCAFFERTY

B.Sc., University of Illinois Urbana-Champaign, 1999
M.Sc., New Jersey Institute of Technology, 2008

Submitted in partial fulfillment of the

requirements for the degree of

Master of Science

2024

Approved by

First Reader

Susan E. White, M.D.
Clinical Associate Professor of Obstetrics & Gynecology

Second Reader

John R. Weinstein, Ph.D. M.S.
Assistant Professor of Medicine

"The legal status of abortion makes no difference to a woman's need for an abortion, but it dramatically affects her access to safe abortion."

"Abortion is healthcare – Removing barriers to abortion protects women's lives, health and human rights"

- World Health Organization

DEDICATION

To my spouse Dennis, for inspiring my healthcare journey and his unwavering support in making it possible.

To my kids, follow your dreams even if it means taking the road less traveled by.

With effort and a supportive village, you can achieve anything.

To my parents, for your unconditional love and faith in me.

To my family, friends and mentors, for steering me back on track and believing I would survive, maybe even thrive, along this journey.

ACKNOWLEDGMENTS

Many thanks to Dr White, my thesis advisor, and Dr Weinstein, Director of Research, for their guidance and patience throughout the thesis process. Sincere appreciation also goes to David Flynn for his invaluable research support. Finally, thank you to Dr Woodhams for the inspiring lectures that precipitated this thesis topic.

IMPACT OF STATE ABORTION POLICIES ON MATERNAL MORTALITY POST DOBBS V JACKSON

SHUHUI JOYCE McCAFFERTY

ABSTRACT

The persistently elevated maternal mortality rate in the United States is a well-documented, significant issue. Access to safe, legal abortions is a powerful weapon in reducing maternal mortality. However, the US Supreme Court removed federal protection of abortion access in its *Dobbs v Jackson* ruling on 24 June 2022. While previous literature has found reduced abortion access to be associated with increased maternal mortality, there is insufficient data to answer whether states' implementation of restrictive abortion policies in the wake of *Dobbs v Jackson* will result in a similar outcome. The proposed study is a prospective ecological analysis of maternal mortality metrics in the United States from 2018-2027. It uses an abortion policy composite index to quantify the restrictiveness of states' abortion policies and reviews both maternal mortality ratios per 100,000 births (WHO definition) and per 100,000 pregnancies. Data gathered here has the potential to drive evidence-based policy changes to reduce maternal mortality in the future.

TABLE OF CONTENTS

DEDICATION v

ACKNOWLEDGMENTS vi

ABSTRACT vii

TABLE OF CONTENTS viii

LIST OF TABLES x

LIST OF FIGURES xi

GLOSSARY xii

CHAPTER ONE - INTRODUCTION 1

Background 1

Statement of the Problem 11

Hypothesis 11

Objectives and Specific Aims 11

CHAPTER TWO – LITERATURE REVIEW 13

Overview 13

Additional Considerations 24

Pregnancy Check Box 24

Texas – House Bill 2 (HB2) and Senate Bill 8 (SB8) 27

Impact of Race/ Ethnicity 29

Summary 31

CHAPTER THREE - METHODS 32

Study Design 32

Measures and Data Collection 33
Abortion Policy Composite Index (APCI) 33
Additional Study Variables 34
Data Analysis 36
Covariates 36
Timeline and Resources 37
Institutional Review Board 37
CHAPTER FOUR - CONCLUSION 38
Discussion 38
Limitations 39
Summary and Public Health Significance 40
BIBLIOGRAPHY 42
CURRICULUM VITAE 51

LIST OF TABLES

Table 1. Percentage, rate and ratio of reported abortions, by age group, from 43 reporting areas, United States, 2021 6

Table 2. States and Maternal Death by Tertile of State Abortion Policy Composite Index: United States, 2015-2018 21

Table 3. Association (ARR) between Total Maternal Mortality (TMM), Maternal Mortality (MM), and Late Maternal Mortality (LMM) and Abortion Policies: United States, 2015-2018 22

Table 4. Association between race stratified Total Maternal Mortality (TMM), Maternal Mortality (MM) and Late Maternal Mortality (LMM) and Abortion Policy Composite Index, 2015-2018 22

Table 5. Maternal mortality and late maternal mortality, using the 2003-2017 vs 2018 coding methods, in the US, 2018 26

Table 6. Summary of how pertinent literature review studies address pregnancy check box issue 27

Table 7. State-level policies used to determine Abortion Policy Composite Index (APCI) and corresponding designated coding 34

Table 8. Covariates in study and corresponding measures 36

LIST OF FIGURES

Figure 1. Maternal Mortality Ratio in Group of 8 (G8) Countries, 2000-2020 1

Figure 2. Maternal Mortality Ratio in United States, 1969-2022 2

Figure 3. Abortion Trends in United States, 1973-2021 5

Figure 4. Monthly abortion data from US states where abortion is banned, April 2022 to Dec 2023 9

Figure 5. Comparison of abortion policy restrictiveness in 2000 vs 7 June 2024 10

Figure 6. Maternal Mortality Ratio (MMR) of each state and District of Columbia, United States, 2018-2022 10

Figure 7. Estimated increases in rate of maternal deaths per 100,000 pregnancies (percentage increases noted in parenthesis after named state) if abortions are received vs if abortions are banned, 2020 16

Figure 8. Longitudinal trends in maternal mortality ratios, per data from Global Health Data Exchange, in states with protective, neutral or restrictive abortion policies, 1995-2017 18

Figure 9. Trend in Maternal Mortality Ratio over 2 time periods for states with restrictive, neutral and protective abortion policies, delineated by race, over 2 time periods 18

Figure 10. Visual presentation of terms associated with maternal mortality 19

Figure 11. Observed vs predicted MMR: United States, 1999-2017 25

Figure 12. Maternal Mortality Rate, by race: United States, 2022 29

Figure 13. Pregnancy Related Mortality Ratios in the US by race and education level, 2007-2016 30

GLOSSARY

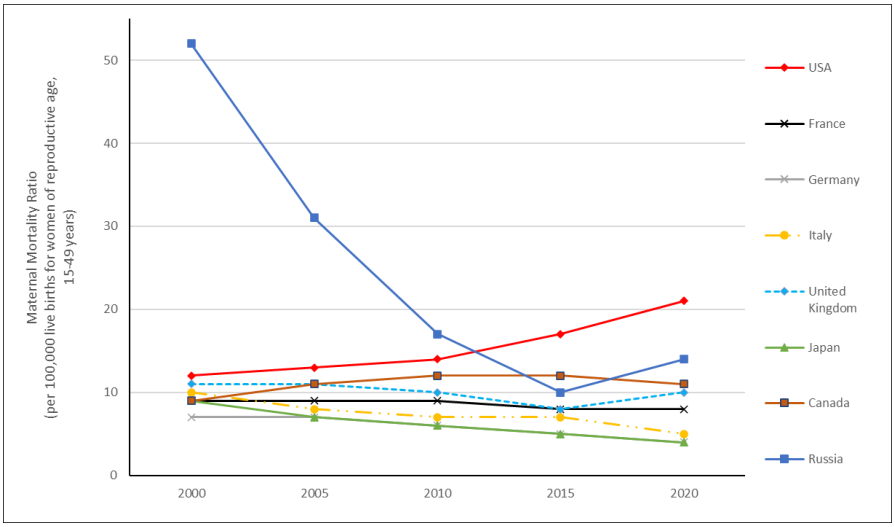
- ***Late Maternal Mortality (LMM)*** – death of a pregnant person attributed directly or indirectly to delivery of neonate, that occurs within 43-365 days postpartum.[1] This is identified when the cause of death is assigned ICD-10 codes O96-O97.[2]
- ***Maternal Mortality (MM)*** – death of a pregnant person during pregnancy or within 42 days postpartum, unless cause of death is unrelated to pregnancy (eg. incidental trauma, murder, suicide).[1] This is identified when the cause of death is assigned International Statistical Classification of Diseases, 10th Revision (ICD-10) codes A34, O00–O95, and O98–O99.[3]
- ***Maternal Mortality Ratio or Rate (MMR)*** – maternal mortality per 100,000 live births during defined time period, representing maternal mortality risk in proportion to live births.[1] While it is ideal that the denominator accounts for all pregnancies, it is often difficulty to obtain accurate values for abortions, miscarriages and fetal deaths.[4,5] Additionally, due to the low incidence of maternal deaths, MMRs can oscillate widely each year.[6]
- ***Total Maternal Mortality (TMM)*** – death of a pregnant person attributed directly or indirectly to pregnancy or delivery, that occurs during pregnancy or within 365 days postpartum.[7] Sometimes also referred to as "Pregnancy-Related Mortality" (PRM).[4] This is identified when the cause of death is assigned ICD-10 codes A34, O00–O96, and O98–O99 (excluding O97).[7]

CHAPTER ONE - INTRODUCTION

Background

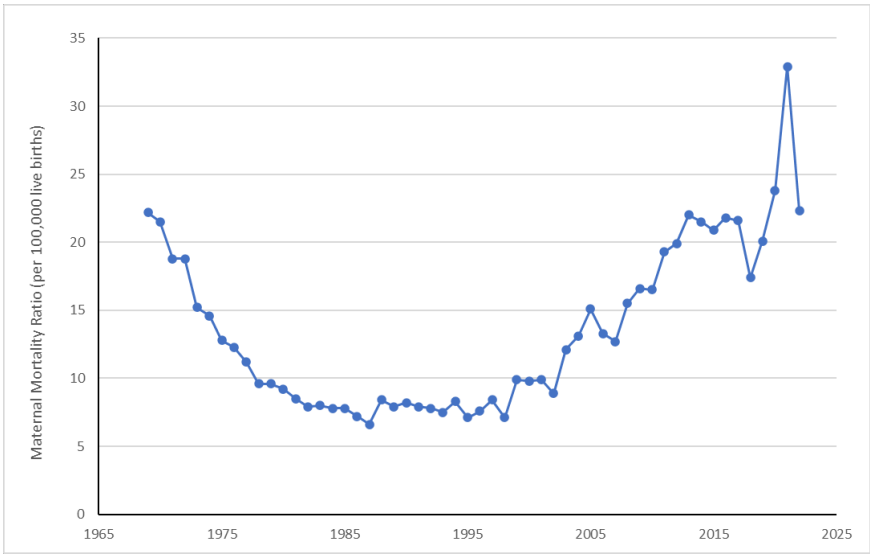
During the period of 1990 to 2015, maternal mortality decreased by 44% globally and decreased by 48% for industrialized countries.[8] Despite this decreasing global trend in maternal mortality, the maternal mortality rate (MMR) in the United States remains persistently elevated, especially in comparison with other G8 countries (Figure 1) (Note: The organization Group of Eight (G8) industrialized countries was formed in 1975 and currently includes the United States, France, Germany, Italy, United Kingdom, Japan, Canada and Russia).[9] In 2017, the World Health Organization (WHO) reported the United States and the Dominican Republic as the only 2 countries with marked rises in MMRs since 2000.[4] The MMR for the US peaked in 2021 at 32.9 deaths per 100,000 births, the highest since 1964, decreasing to 22.3 deaths per 100.000 births in 2022[3,10] (Figure 2).

Figure 1. Maternal Mortality Ratio in Group of 8 (G8) Countries, 2000-2020



Data from Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division.[1]

Figure 2. Maternal Mortality Ratio in United States, 1969-2022



Data from Maternal Mortality and Related Concepts (1969-1998)[11], CA-PMSS Surveillance Report: Pregnancy-Related Deaths in California, 2012-2020 (1999-2017)[12] and Maternal Mortality Rates in the United States, 2022 (2018-2022).[3]

Population based research by Raymond and Grimes published in 2012 concluded that the mortality risk of childbirth is 14 times greater than the mortality risk of legal induced abortion.[13] A more recent paper using multiple decrement pregnancy life tables to simulate the risk of continuing a pregnancy compared to undergoing an abortion concluded that in 2020, the risk of death in continued pregnancy was 35-39 times greater than induced abortion.[14] These two studies show that the risk of pregnancy and childbirth far outweighs the risks of a legal abortion, therefore reducing MMR with adequate access to the procedure.

Conversely, unsafe abortions cause 4.7%-13.2% of global maternal deaths each year.[15] "Unsafe abortion" is defined by WHO as one that is performed by an inadequately trained provider and/ or in a facility that does not meet appropriate medical

requirements.[15] Factors such as polymicrobial infections, presence of necrotic tissue in the uterus, and hypervascularity of the uterus and placenta create conditions that allow septic abortions to progress into bacteremia in up to 60% of cases.[16] Left untreated, an infection from an unsafe abortion can rapidly result in death from sepsis in hours.[16] Delayed or denied access to abortions can contribute to increased MMRs.

Additionally, legalizing abortion allows pregnant people to access abortions earlier in the pregnancy when risks of complications are lower. Per Stubblefield et. al., after 8 weeks of gestation, abortion complication rates increase 38% per week.[17] Pregnant patients also have the option to undergo medical abortions prior to 10 weeks gestation instead of surgical abortions after 11 weeks gestation.[18]

A dilemma arises when a pregnant person who wants an abortion is not able to access one legally. They must decide whether to continue the pregnancy, undergo an illegal and potentially unsafe procedure, or pursue obtaining a legal abortion in a different state, therefore delaying the procedure during their pregnancy. All these options increase the pregnant person's risk of morbidity and/or mortality. Therefore, the WHO recommends access to safe, legal abortion as an effective tool in reducing global maternal mortality and morbidity.[1] The Supreme Court ruling *Roe v Wade* issued on 22 January 1973 effectually legalized abortion in all states. It should be noted that abortion was already legal in 17 states at the time of this ruling.

In the US, the Centers for Disease Control and Prevention (CDC) started to record the number of legal abortions, the makeup of those receiving abortions and deaths

associated with abortions beginning in 1969.[19] The CDC considers a death to be abortion-related if death is directly caused by the procedure, or arises as a sequela of termination.[19]

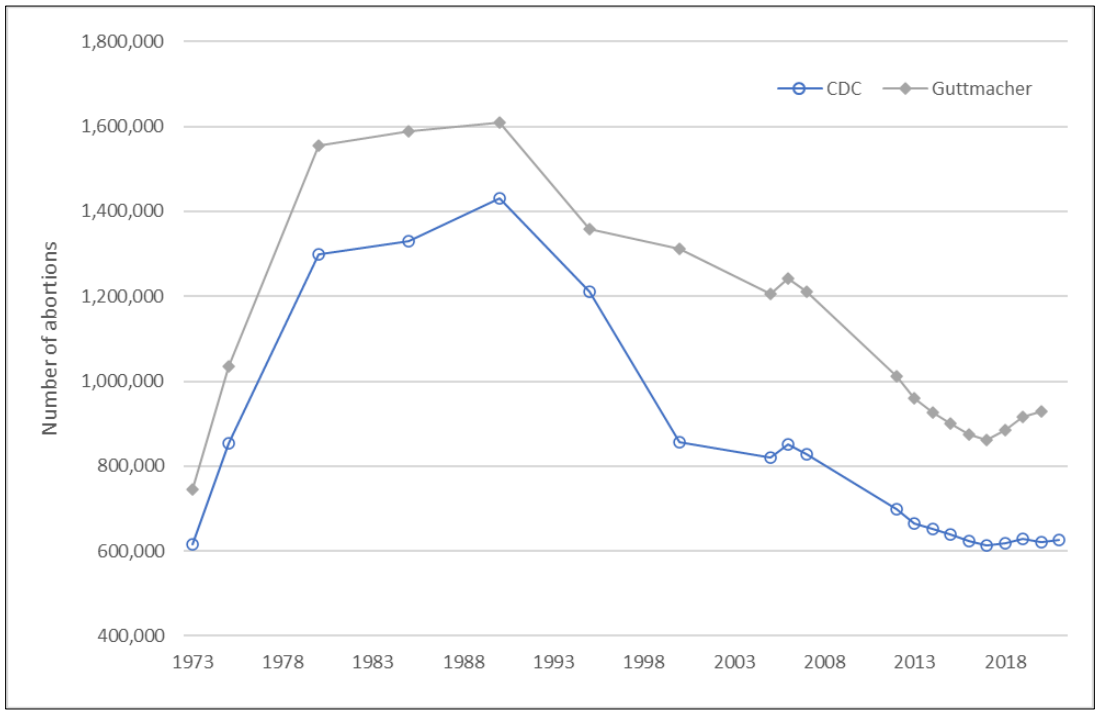
It should be emphasized that the definition of legal induced abortion excludes fetal death during pregnancy, spontaneous abortion, ectopic pregnancy, or retained products of conception.[19] Of note, reporting of abortion data from each state's health agency is voluntary, not mandatory. The CDC obtains census and birth data to calculate abortion rates ("number of abortions per 1,000 women aged 15-44 years"), abortion ratios ("number of abortions per 1,000 live births"), and estimated pregnancy rates.[19] Abortion data is also collated, analyzed, reported and used for advocacy by the Guttmacher Institute. Guttmacher collects data directly from all healthcare facilities that offer abortions.[20] As a result, the number of abortions reported by Guttmacher typically exceed that reported by the CDC (Figure 3). While the actual numbers may differ between these two sources, the overall directional trend is remarkably consistent.

In the wake of the historic *Roe v Wade* judgement, the abortion incidence increased steadily and peaked in 1990 at ~1.6 million[20] (Figure 3). A facility in California reported that despite an increase in annual abortions from 0 to 3,000 from 1966 to 1971, annual septic abortions decreased from 646 to <150.[21] This was consistent with a 1999 CDC report that attributed the 89% mortality reduction in illegal septic abortions from 1950-1973 to the legalization of abortion in the 1960s.[21] Despite the tremendous increase in legal abortions performed, maternal mortality decreased (Figure 2 and Figure 3).

Since 1990, the number of abortions steadily decreased before plateauing in 2017 at 863,325.[20] Possible factors contributing to this decrease include postponement of

sexual relationships by adolescents and young adults and the availability of improved contraceptive methods with increased contraception access.[20]

Figure 3. Abortion Trends in United States, 1973-2021



Data from Health, United States, 2011 (CDC and Guttmacher, 1973-2007)[22], Abortion Surveillance — United States, 2021 (CDC, 2012-2021)[19] and Abortion incidence and service availability in the United States, 2020 (Guttmacher, 2012-2020).[20]

Unfortunately, the conversation surrounding abortion is fraught with tension and emotion and can be divisive. Very often, the political and social discourse between pro-life and pro-choice camps drown out the quiet, deliberate contemplation over a very personal and complicated decision. It is estimated that 45% of all pregnancies in the US are unintended and unintended pregnancies account for 95% of abortions.[23] In 2003-2004, a structured survey study of abortion patients (N=1,209, sampled from 11 facilities that collectively accounted for 56% of legal induced abortions within the US in 2000)

regarding the reason(s) for abortion was conducted.[24] Of note, patients had already elected for an abortion when they were surveyed.[24] The age distribution of pregnant patients was 20% ≤19 years, 57% 20-29 years, and 23% ≥ 30 years. The study determined the following reasons for obtaining an abortion: (a) most (74%) felt unprepared for a child; (b) 73% cited financial reasons; (c) 59% of respondents already had at least 1 child and were not certain they could raise another; (d) 38% had decided they did not want more children; and (e) only a minority reported maternal health (12%) or fetal abnormalities (13%).[24] A more recent paper published in 2013 drew similar conclusions about the most common reasons cited for abortion: (a) 40% "not financially prepared"; (b) 36% "not the right time for a baby".[25]

Meanwhile, the birth rate in the US for females between 15-19 years has declined by 78% from 1991 to 2021.[26] Simultaneously, the adolescent abortion rate has experienced the sharpest decline from 2012 to 2021 compared to all other age groups.[19] The 2021 CDC abortion surveillance data (Table 1)suggests that those choosing abortions are older, pregnant people with thoughtful reasons rooted in financial insecurity and who feel unable to care for additional children.[24]

Table 1. Percentage, rate and ratio of reported abortions, by age group, from 43 reporting areas, United States, 2021

Age Group (years)	Percentage	Abortion Rate	Abortion Ratio
<15	0.2	0.4	780
15-19	8.2	5.4	366
20-24	28.5	18.6	290
25-29	28.7	18.3	189
30-34	20.2	12.5	127
35-39	10.6	6.8	132
≥ 40	3.5	2.4	198

Table adapted from Abortion Surveillance - United States, 2021.[19]

Although the *Roe v Wade* ruling enabled pregnant people to receive an abortion during the first trimester if desired, the crux of the ruling centered around the right to privacy without securing a constitutional right to abortion.[27] As a result, states/ legislators/ anti-abortion advocates have been able to institute policies that gradually placed increasing barriers to abortion as noted below.

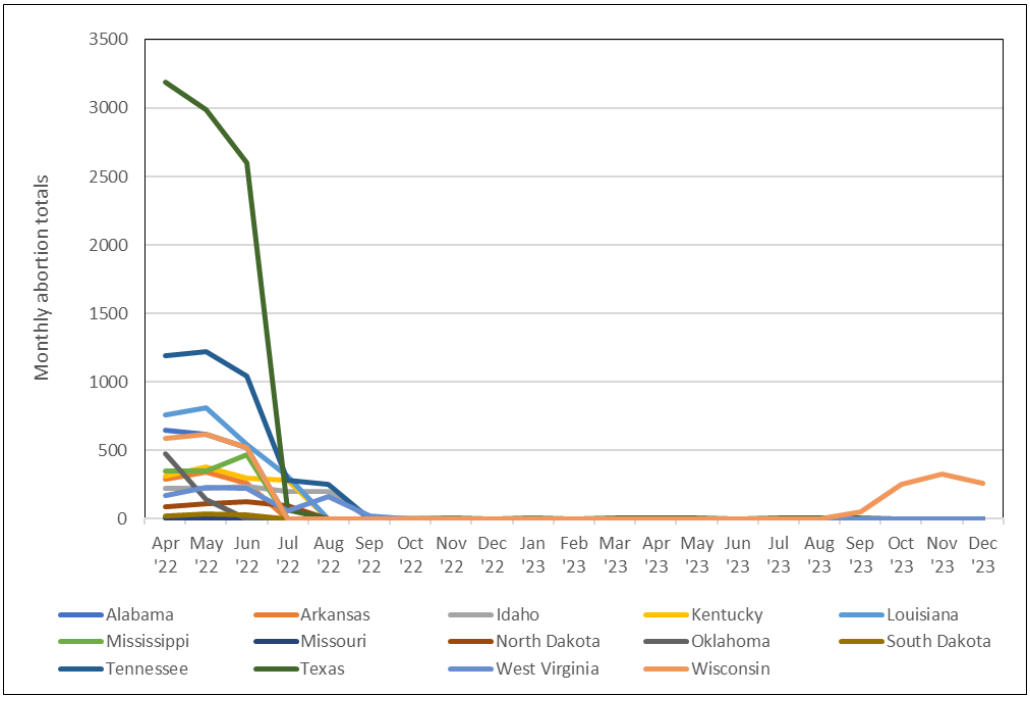
- 1967-1970 – abortion is legal in 17 states[28,29]
- 1969 – CDC begins abortion surveillance[19]
- 1973 – *Roe v Wade*: first trimester abortion legal in all states
- 1976 – Hyde Amendment: prevents use of federal funds for abortions[28]
- 1982 – Abortion Control Act (ACA) passed in Pennsylvania: mandated 24-h delay between initial consult and abortion procedure, notification to spouse (if married) or parent (if minor) and facility reporting[28]
- 1992 – *Planned Parenthood v Casey*: Concept of undue burden defined ("effect of placing a substantial obstacle in the path of a woman seeking an abortion of a nonviable fetus") and applied to abortion access.[28] ACA requirements except for spousal notification upheld.[28]
- 2000 – FDA approval of Mifepristone, combined with misoprostol, for medical abortion ≤7 weeks gestation
- 2003 – First implementation of pregnancy checkbox addition to US Standard Certificate of Death[30]
- 2011 – Texas Sonogram Law: requires physician to conduct sonogram at least 24-hours before performing an abortion[31]

- 2013 - Texas legislature passed House Bill 2 (HB2), one of several Targeted Regulation of Abortion Providers (TRAP) laws that are not founded in evidence based medicine.[32] Some of the stringent requirements of HB2 included admitting privileges for physicians in local hospitals within 30 miles of their clinic and ambulatory surgical facilities for abortions.[33]
- 2014 – Affordable Care Act State Medicaid expansion, if electively adopted by states, enables low-income women of reproductive age, with or without children, to access health insurance coverage for family planning services (e.g. contraception and abortion), prenatal care, and extended post-partum care[34]
- March 2016 - FDA approval of Mifepristone, combined with misoprostol, for medical abortion ≤10 weeks gestation[18]
- June 2016 – *Whole Woman's Health v Hellerstedt*: 2013 Texas HB2 requirements were considered an "undue burden"[28] and rejected by the U.S Supreme Court[33]
- 2018 – Complete implementation of a pregnancy checkbox addition to US Standard Certificate of Death[35]
- 2020 – 53% of abortions are managed medically (i.e. via a combination of Mifepristone and Misoprostol)[20]
- 2021 – "Texas Heartbeat Act"/ Senate Bill 8 (SB8): bans abortion once fetal heartbeat detected (~6 weeks gestation) and ability of private citizen to sue anyone who disregards SB8[28,36]

- June 2022 – *Dobbs v Jackson Women's Health Organization*: Supreme Court rules that Mississippi can "limit gestational age of abortion before viability", reversing *Roe* and *Casey*, removing federal protection of abortion access[28]
- 2023 - 63% of abortions are managed medically[37]

The Supreme Court's pivotal ruling on *Dobbs v Jackson* had far reaching consequences. The controversial decision allowed states to enact laws reducing abortion access, even prohibiting abortions entirely.[28] The continuing study #We Count, spearheaded by the Society for Family Planning, noted a reduction in the national abortion rate from 13.4 per 1,000 women in April 2022 to 12.6 per 1,000 women in December 2022[38], with substantial reductions in states with total bans (Figure 4).[39]

Figure 4. Monthly abortion data from US states where abortion is banned, April 2022 to Dec 2023

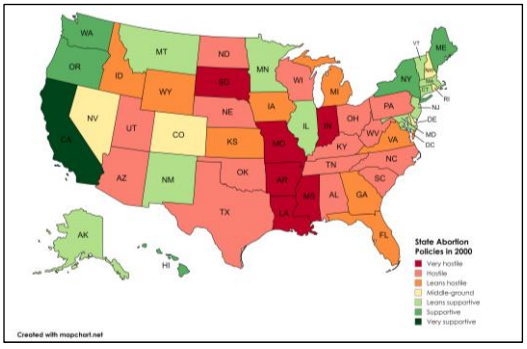


From from #WeCount Report, April 2022 to December 2023.[39]

As of May 2024, 14 states have completely banned abortion, 7 states banned abortion at ~18 weeks gestation, 20 states banned abortion at ≥18 weeks gestation, and only 9 states and the District of Columbia have no gestational age restrictions.[40] The 14 states with complete abortion bans are Alabama, Arkansas, Idaho, Kentucky, Louisiana, Mississippi, Missouri, North Dakota, Oklahoma, South Dakota, Tennessee, Texas, West Virginia, Wisconsin.[39] The shift towards reduced abortion access is visually presented in Figure 5. Women's health advocates are projecting increases in MMR in response to this regression in abortion access, exacerbating disparities in state maternal mortalities (Figure 6). As an example, the 2018-2022 MMR was as low as 10.5 per 100,000 in California and as high as 41.1 per 100,000 in Tennessee.[41]

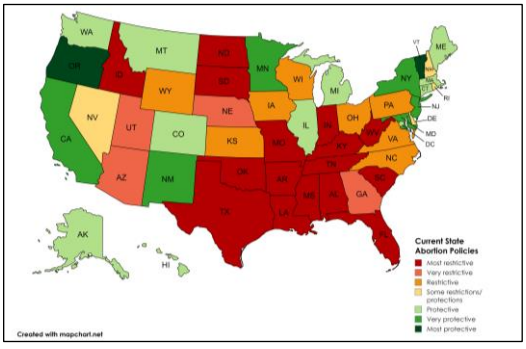
Figure 5. Comparison of abortion policy restrictiveness in 2000 vs 7 June 2024

In 2000 (as of 30 December 2020)



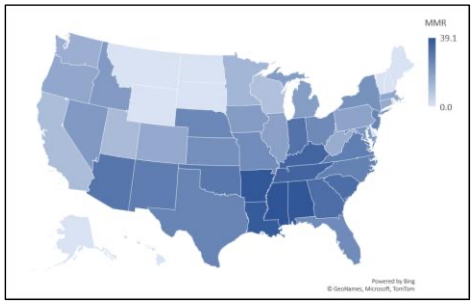
Adapted from State Abortion Policy Landscape: From Hostile to Supportive.[42]

As of 7 June 2024



Adapted from Interactive Map: US Abortion Policies and Access After Roe.[43]

Figure 6. Maternal Mortality Ratio (MMR) of each state and District of Columbia, United States, 2018-2022



Adapted from Maternal deaths and mortality rates: Each state, the District of Columbia, United States, 2018-2022.[44]

Despite increasingly restrictive rules governing abortion and an initial decrease in abortions immediately post *Dobbs v Jackson*, the Guttmacher Institute reports sustained recent increases in the number of abortions.[45] It is estimated that 1,037,000 abortions occurred in 2023, an abortion rate of 15.9 abortions per 1,000 women of reproductive age.[45] In fact, based on the abortion rates in 2020, it is estimated that 24.7% of women (or almost 1 in 4 women) within 15-44 years are likely to have undergone an abortion prior to their 45th birthday.[46] Access to safe abortions is essential to inclusive, evidence based standard of reproductive health care within the United States, and should be available to all to pregnant people, without geographical or political limitations, a stance championed by the Institute for Women's Policy Research.[47]

Statement of the Problem

Despite the growing body of literature identifying the association of reduced abortion access via state policies and maternal mortality, due to the currency of the *Dobbs v Jackson* ruling in June 2022, there is a paucity of data on the impact of reduced abortion access post *Dobbs* on maternal mortality.

Hypothesis

States that implement more restrictive abortion policies post *Dobbs v Jackson* will experience an increase in maternal mortality rates.

Objectives and Specific Aims

This thesis will review recent research into the impact of restrictive state abortion policies on maternal mortality pre-*Dobbs* and propose a study to determine if an

association between more restrictive abortion policies and increased maternal mortality ratios post *Dobbs v Jackson* exists.

The specific aims of the proposed study include:

(1) Using an index to quantify restrictiveness of each state's abortion policy

(2) Collating data for maternal mortality (MM), maternal mortality ratio (MMR), late maternal mortality (LMM), total maternal mortality (TMM) and live births from appropriate databases. Data should be stratified by race when race/ ethnicity data is available.

(3) Evaluating the association between abortion restrictiveness index and maternal mortality metrics.

CHAPTER TWO – LITERATURE REVIEW

Overview

In 1989, the US Surgeon General determined that there was insufficient evidence around the impact of abortions on women's health, which resulted in the genesis of what is often referred to as "The Turnaway Study".[48] This seminal prospective longitudinal study conducted by UCSF - ANSIRH (University of California San Francisco - Advancing New Standards in Reproductive Health) investigated the mental, physical and socioeconomic impact on women with unintended pregnancies who received an abortion compared to those who were denied access due to gestational limitations (i.e. turned away).[49] Approximately 1,000 pregnant women were recruited from 30 abortion facilities in 21 states within the United States during the time period 1 January 2008 to 31 December 2010.[48] The eligibility criteria included conversational fluency in English or Spanish, at least 15 years old, and no known fetal abnormalities.[50] Study subjects were interviewed via telephone 1 week after seeking abortion, and every 6 months over the next 5 years.[48]

Data from this pivotal, groundbreaking study resulted in the publication of more than 50 papers in scholarly journals.[48,49] Some notable conclusions include women who were denied abortions and subsequently gave birth reported more life-endangering conditions (e.g. eclampsia and post-partum hemorrhage) with one maternal death.[51] These women also reported more chronic headaches/ migraines and increased arthralgia.[52]. In contrast, no maternal deaths were associated with abortion during this study.[51] Those who were denied abortions reported increased depression and anxiety,

lower self-esteem and reduced satisfaction with life compared to women who received abortions who reported comparable or improved emotional health. [48] Women who received abortions experienced reduced domestic violence from the biological father of their child.[53] There were also economic repercussions for women who gave birth and their children, since they were more likely to remain in poverty for 4 years after being turned away than women who received abortions. [54,55] Children born to women who were denied abortions were less connected to their mothers, compared to subsequent children born of women who received abortions[56], and existing children of women who were denied abortions had lower child development scores.[55] Despite previously noted risks and difficulties associated with continuing the pregnancy, giving birth and parenting, 91% of study participants who gave birth decided to parent instead of giving up their child for adoption.[57]

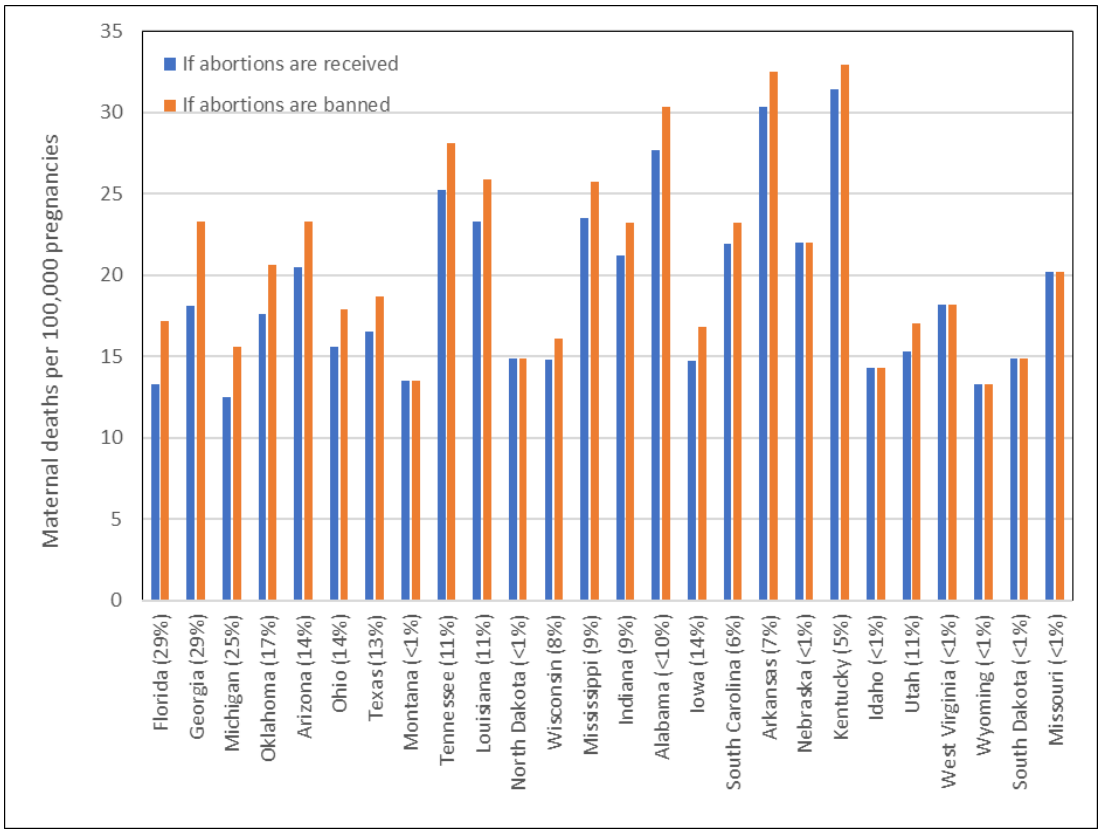
Thus, abortion denial has vast and complex repercussions for not only the pregnant person's life, but that of their children as well. Therefore, much concern has developed around the impact of the *Dobbs v Jackson* decision since states can now deny abortions via increased restrictions.

One often cited paper is "The maternal mortality consequences of losing abortion access" by Stevenson, Root and Menken.[5] Their approach predicts the rise in maternal deaths in the hypothetical setting of a complete national ban on abortion under *ceteris paribus* conditions (i.e. if all else remains equal[58]). The premise of the argument is that induced abortion is significantly safer than forced continued pregnancy and childbirth. This argument is supported by the significantly elevated CDC reported MMR of 22.3

deaths per 100,000 live births (2022) when compared to the 0.45 abortion-related deaths per 100,000 abortions (2013-2020).[3,19] However, this excludes consideration of the following factors that may underestimate maternal mortality in this study: (a) the elevated risk of pregnancy/childbirth associated with adolescents and increased maternal age; (b) potential increase in illegal unsafe abortions; (c) increased exposure to domestic violence; (d) state racial/ ethnic composition of people giving birth or seeking abortions; (e) annual changes in MMR and pregnancy rates.

The study used demographic methods previously described by Stevenson in 2021[59] and 2020 data (national and state abortion incidence, birth incidences and maternal mortality) to estimate increases in maternal deaths. While the denominator in the WHO definition of MMR is live births, this study calculated mortality rates with the denominator of all pregnancies (i.e. summation of live births, abortions, and fetal losses) based on the presupposition that all pregnancies risk maternal death, reporting results as maternal deaths per 100,000 pregnancies.[5] With a complete national abortion ban, this study estimated a 13% increase in the annual number of maternal deaths from 861 to 969 in the first year and a 24% increase from 861 to 1071 in subsequent years with the highest increase (39%) for non-Hispanic Black people.[5] Interestingly, in states where abortion access is already limited pre-*Dobbs* with elevated MMRs, the estimated additional increase in maternal deaths resulting from a total abortion ban post-*Dobbs* is muted. For example, Missouri, where the 2018-2020 MMR is 25.2 and abortion ratio is 0.00, the estimated increase in maternal deaths with a total abortion ban is <1% (Figure 7).[5]

Figure 7. Estimated increases in rate of maternal deaths per 100,000 pregnancies (percentage increases noted in parenthesis after named state) if abortions are received vs if abortions are banned, 2020



Adapted from The maternal mortality consequences of losing abortion access.[5]

While the study by Stevenson et. al. quantified the impact via additional maternal deaths, there are several glaring limitations of the study. First, the results are based on a theoretical situation whereby abortion is completely banned in the United States *ceteris paribus*, therefore potentially overestimating increases in maternal mortality. Conversely, the study assumes that all pregnancies (e.g. high risk, geriatric, or undesired pregnancies, maternal race and ethnicity, unsafe abortions, lack of pre-natal care etc.) carry the same mortality risk, which may underestimate increases in maternal mortality. Thirdly, since it defines rates of maternal deaths based on an estimated total number of pregnancies, the

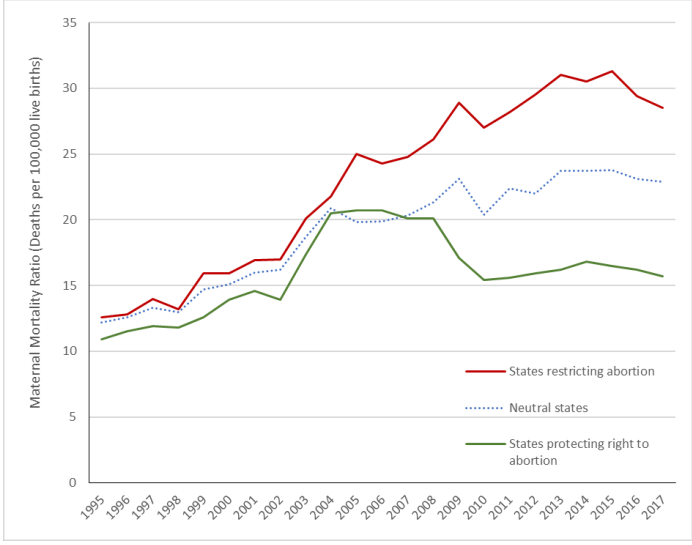
calculated rates are not directly comparable to the CDC reported maternal mortality rates, which are based on total number of live births.

To better explore the association between abortion restrictions and maternal mortality in the US, Addante et. al. conducted a retrospective study for the period 1995-2017[60], prior to *Dobbs v Jackson,* published in March 2021. These years coincided with increasing MMRs in the US and the disparate implementation of abortion restrictions in various states, which resulted in inequitable abortion access across the country. While previous studies had identified an inverse directional connection between a reduction in women's reproductive rights and an increase in adverse maternal outcomes (e.g. low infant birth weight, pre-term birth, study specific composite scores for women's/children's health) [61,62], this was the first study that focused on the impact of abortion restrictions on maternal mortality.[60] Its hypothesis was that reduced abortion access would result in increased maternal mortality. The study sourced maternal mortality data from both the CDC WONDER and Global Health Data Exchanges databases and applied the WHO definitions for maternal mortality and maternal mortality ratio (MMR). States' abortion restrictions were categorized based on abortion policy information collated and published by the Guttmacher Institute.

Data from both databases concluded significantly higher MMRs in restrictive states and significantly lower MMRs in protective states (Figure 8). The authors offer several possible explanations for this association. Firstly, those with higher risk pregnancies who continue their pregnancy due to difficulty obtaining abortions in restrictive states are more likely to experience adverse maternal outcomes. Secondly,

abortion restrictive states may experience collateral decreased access to contraception due to closure of abortion clinics, resulting in greater incidence of unintended pregnancies which have been linked to greater maternal mortality/morbidity.[60]

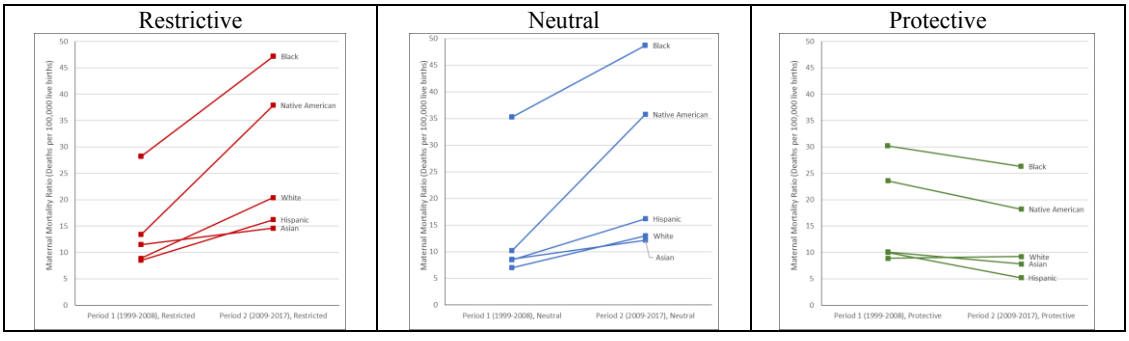
Figure 8. Longitudinal trends in maternal mortality ratios, per data from Global Health Data Exchange, in states with protective, neutral or restrictive abortion policies, 1995-2017



Adapted from The association between state-level abortion restrictions and maternal mortality in the United States, 1995-2017.[60]

One disturbing but not unexpected finding, was the stronger association between increased MMR and abortion restrictiveness for minority women (Figure 9), highlighting the disproportionate racial impact of reduced abortion access.

Figure 9. Trend in Maternal Mortality Ratio over 2 time periods for states with restrictive, neutral and protective abortion policies, delineated by race, over 2 time periods

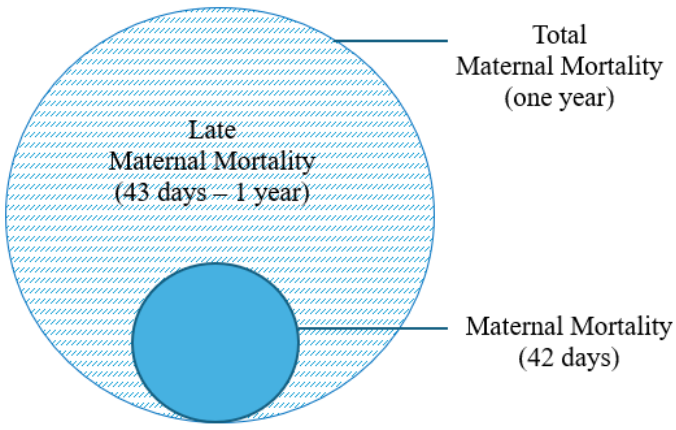


Adapted from The association between state-level abortion restrictions and maternal mortality in the United States, 1995-2017.[60]

Additional sensitivity analyses determined the following: (a) potential overestimation of MMR in Texas did not affect overall results; (b) 2014 eligibility expansion of state Medicaid under the Affordable Care Act demonstrated a minor but statistically meaningful rise in MMR in restrictive states; (c) a statistically valid association between not having a pregnancy check box on the state's death certificate and decreased MMR; (d) similar trends in MMRs if state's abortion restrictiveness status was classified once (based on 2017 status) or reclassified annually.[60]

While the study found a statistically significant association between increased maternal mortality and increased abortion restrictiveness, the authors caution that this association did not necessarily imply a causal relationship since maternal mortality can be negatively impacted by multiple factors not included in the scope of this study (e.g. differences in pregnancy risks, change in California's definition of maternal mortality to include deaths up to 1 year of pregnancy, or unequal impact of individual policies used by Guttmacher to determine state's restrictiveness category).[60]

Figure 10. Visual presentation of terms associated with maternal mortality



Adapted from Maternal Mortality in the United States: A Primer.[4]

Another study investigating the association between abortion restrictions and maternal mortality in the US is the retrospective ecological study performed by Vilda et. al.[7] The study, published in September 2021, examined how differences in state policies on abortion restriction affected maternal mortality (MM), late maternal mortality (LMM) and total maternal mortality (TMM) in the time period 2015-2018 (Figure 10). The hypothesis was that increased state level abortion restrictions would result in increased maternal mortality, similar to the previously discussed study conducted by Addante et. al. One key difference between the two studies is that instead of merely categorizing states as protective, neutral or restrictive[60], the restrictiveness of the abortion policies were quantified via an abortion policy composite index.[7] This index was calculated based on the following eight state policies: (a) "state mandated counseling" with pre-approved brochures written to discourage abortion, prior to the procedure; (b) compulsory delay, typically 24 hours, between counseling and abortion procedure; (c) required ultrasound prior to abortion; (d) gestational age limitations; (e) requiring physicians to perform abortions and prohibiting non-physician healthcare providers (e.g. appropriately trained/ qualified physician assistants, nurse practitioners, or nurse midwives) from abortion care; (f) private health insurance plans that exclude abortions; (g) preclude use of public funding (e.g. state Medicaid) to pay for abortions; and (h) parental notification and/or consent for unmarried minors seeking abortion.[7] Each policy from (a) to (g) was assigned a value of "1" if the policy was present and "0" if not the policy was not present in the state. The only exception was (h) which was assigned either "0.5" or "0" since it affected

only minors, a small subset of the total population seeking abortions. To calculate this index, abortion policy information for states, effective on 1 January 2015, was obtained from data collated and published by the Guttmacher Institute. The states were then divided equally into tertiles ranked "low, moderate, high", where "high" denoted the third of states with most restrictive abortion policies.[7] Another variation from Addante et. al.'s study is the evaluation of total maternal mortality (TMM) as the primary outcome of interest. TMM includes all pregnancy related deaths, during pregnancy and up to 1 year post-partum[7], whereas MM, studied by Addante, is limited to pregnancy and only up to 42 days post-partum. A third difference is the exclusion of California from this study due to its atypical implementation of the pregnancy checkbox policy.

Table 2. States and Maternal Death by Tertile of State Abortion Policy Composite Index: United States, 2015-2018

Abortion Policy Index	Number of States	States	Total Maternal Mortality	Maternal Mortality	Late Maternal Mortality
Low	15	CA, CT, DC, HI, IL, MD, ME, MT, NH, NJ, NM, NY, OR, VT, WA	1,004	499	206
Moderate	17	AK, AZ, CO, DE, FL, IA, KY, MA, MN, NV, OH, PA, RI, TN, WI, WV, WY	999	714	285
High	19	AL, AR, GA, ID, IN, KS, LA, MI, MO, MS, NC, ND, NE, OK, SC, SD, TX, UT, VA	1,782	1,311	471

Table adapted from State Abortion Policies and Maternal Death in the United States, 2015-2018.[7]

Statistical analysis yielded the following notable results: (a) Raw TMM, MM and LMM rates were significantly higher in the most restrictive tertile of states (Table 2); (b) In adjusted models, an increase in abortion policy index by +1 was affiliated with a 7% increase in TMM (Table 3); (c) Out of the eight abortion policies represented in the index, the two that were associated with the greatest impact to TMM and MM were the

physician only requirement for abortion care (51% higher TMM and 35% higher MM) and restriction of public funding (29% higher TMM)[7] (Table 3).

Table 3. Association (ARR) between Total Maternal Mortality (TMM), Maternal Mortality (MM), and Late Maternal Mortality (LMM) and Abortion Policies: United States, 2015-2018

	TMM	MM	LMM
Abortion policy composite index	1.07	1.02	1.01
State abortion policies (yes vs no)			
• Mandated counseling	1.13	0.98	1.00
• Waiting period	1.16	1.05	0.99
• Ultrasound requirement	1.20	1.07	0.94
• Parent involvement for minors	1.09	0.94	1.25
• Gestational age restrictions	1.10	0.91	0.89
• Licensed physician requirement	1.51	1.35	1.12
• Private insurance coverage limited	1.26	1.21	1.20
• Public funds restricted	1.29	1.09	1.19

Note: ARR = Adjusted Rate Ratio. All estimates for MM and LMM exclude data from California. All models adjusted for state-level poverty, unemployment, % population with bachelor's degree or higher, % non-Hispanic White population, % urban population, % foreign-born population, Medicaid expansion status, Medicaid expenditure per capita, average % of births covered by Medicaid, and average % of births to women aged 35 years or older.

Table adapted from State Abortion Policies and Maternal Death in the United States, 2015-2018.[7]

Table 4. Association between race stratified Total Maternal Mortality (TMM), Maternal Mortality (MM) and Late Maternal Mortality (LMM) and Abortion Policy Composite Index, 2015-2018

	Non-Hispanic White			Non-Hispanic Black			Hispanic		
	TMM	MM	LMM	TMM	MM	LMM	TMM	MM	LMM
Abortion policy composite index, ARR	1.06	1.05	0.99	0.98	0.95	0.99	1.01	0.98	0.91
Number of maternal deaths	1,728	1,165	489	1,210	848	312	615	366	115
Number of live births	8,082,036	7,564,573		2,233,216	2,139,606		3,626,302	2,733,569	

Note. ARR = Adjusted Rate Ratio. All estimates for MM and LMM and counts of deaths and live births in these columns exclude data from California. All models adjusted for state-level poverty, unemployment, % population with bachelor's degree or higher, % non-Hispanic White population, % urban population, % foreign-born population, Medicaid expansion status, Medicaid expenditure per capita, average % of births covered by Medicaid, and average % of births to women aged 35 years or older.

Table adapted from State Abortion Policies and Maternal Death in the United States, 2015-2018.[7]

The most striking result from this study is how the adjusted models identified statistically significant association between the index and TMM only for non-Hispanic Whites (Table 4). The authors concede the comparative smaller absolute counts of

maternal death in the non-Hispanic Black and Hispanic compared to non-Hispanic White populations and, perhaps, the exclusion of California may have reduced the power of this section of the study, contributing to this unexpected finding.[7]

Similarly to Addante et. al.'s study, despite the statistically significant association, causality between the abortion policy composite index and TMM cannot be established. One limitation of the study is the exclusion of California, which accounts for more than 10% of all maternal deaths within the United States[44], possibly reducing the power of the study. Another weakness of the study is its short time period of 2015-2018, making it difficult to interpret study results in context pre/post period.

An international ecological study of 162 countries to examine the association between abortion access and maternal mortality between 1985-2013 was undertaken by Latt et. al. and published in January 2019.[63] Instead of focusing on the restrictiveness of the abortion policies, it took the opposite approach, calculating a "flexibility score".[63] This score (0-7) enumerated how many of the following reasons abortion was permissible in that country: (a) Saving life of pregnant person; (b) Preventing physical maternal morbidity; (c) Preserving mental health of pregnant person; (d) Rape or incest; (e) Possible fetal abnormalities; (f) Socioeconomic reasons; and (g) At request of pregnant person (i.e. no abortion restrictions).[63] To calculate this score, global abortion policies collated by the United Nations Population Division or World Population Policies databases were referenced. The primary outcome of this study was MMR, as defined by the WHO.[1]

This study found that MMR decreased with higher flexibility scores when the flexibility score was treated as a categorical variable (reduction in MMR of 85-144 per 100,000 live births for flexibility scores ≥3 vs 0) or a binary variable (reduction in MMR of 109 per 100,000 live births for flexibility score ≥3 vs <3).[63] Countries with flexibility score of zero had higher MMRs than all other countries with score ≥1. Results from this study appear to support the overarching trend that restricting abortion access is associated with increasing MMRs.

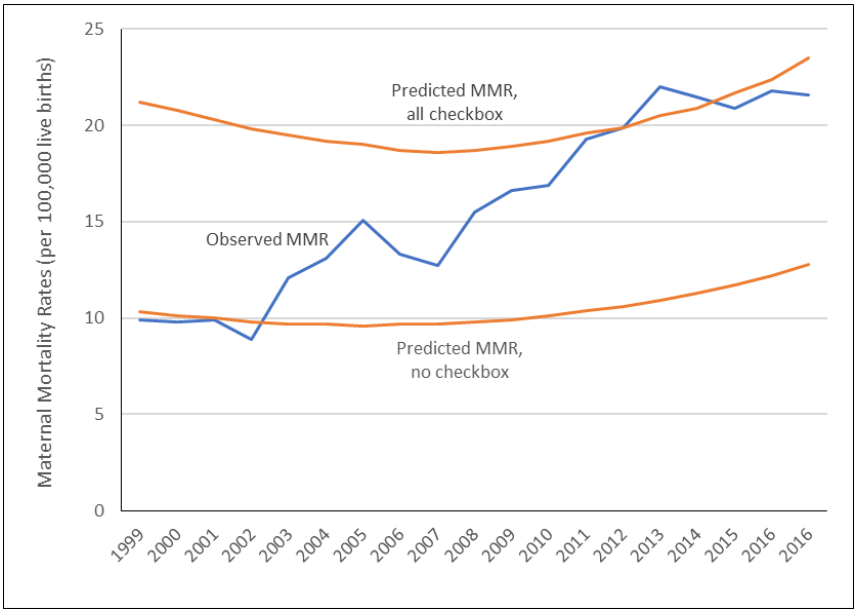
Additional Considerations

Pregnancy Check Box

To prevent underreporting of maternal deaths, the revision of the US Standard Certificate of Death to include a pregnancy checkbox was initiated in 2003.[35] However, this change was not implemented simultaneously in all states but was protracted over many years. It was noted that the US MMR increased significantly from 9.8 per 100,000 births in 2000 to 21.5 per 100,000 births in 2014[30] (Figure 11).

One study conducted by MacDorman MF et. al, estimated that 20.1% of this increase was due to actual changes in MMR while 79.9% was attributed to enhanced identification of maternal deaths.[30] In another study that examined the actual death certificates, only 597 out of the initially 1691 coded maternal deaths were accurate with the remaining 1094 re-coded to non-maternal causes.[2]

Figure 11. Observed vs predicted MMR: United States, 1999-2017



Note: Models were adjusted for age group, race and Hispanic origin, and state of occurrence, and included interactions between these factors and year as well as revision status.

Adapted from The Impact of the Pregnancy Checkbox and Misclassification on Maternal Mortality Trends in the United States, 1999-2017.[64]

In Texas, the reported MMR increased by 100% in the period 2010-2012.[30,65] Of note, Texas implemented the pregnancy checkbox earlier in 2006.[30] Coincidentally, Texas passed a bill requiring a physician conducted sonogram at least 24-hour before performing an abortion in May 2011.[31] This, coupled with closure of several women's healthcare facilities in 2011-2015, provided plausible explanations for the marked MMR increase in Texas.[30] However, when an "enhanced method" requiring confirmation of maternal deaths with other data sources was used to re-identify maternal deaths for 2012, errors in false positive coding of pregnancy status were noted.[65] The MMR for 2012

determined via this "enhanced method" was 14.6 per 100,000 births, not 38.4 per 100,000 births as first determined.[65]

In light of discrepancies possibly attributed to the pregnancy checkbox, no annual MMR was reported by the CDC from 2007 to 2017.[35] Complete implementation of a pregnancy checkbox finally occurred in all 50 states in 2018.[35] This, coupled with the roll-out of the new "2018 method" for coding maternal deaths, significantly improved the consistency of how maternal mortality statistics were derived. The CDC resumed reporting MMRs beginning with the year 2018 and has continued since.[35] It is noteworthy that additional comparative evaluation of the "2018 method" and the "2003-2017 method" observed similar mortality and late mortality number/rates for age groups <40 but highly discrepant values for the >40 age groups (Table 5).[35]

Table 5. Maternal mortality and late maternal mortality, using the 2003-2017 vs 2018 coding methods, in the US, 2018

	Maternal Mortality		**Late Maternal Mortality**	
	2003-207 method	**2018 method**	**2003-207 method**	**2018 method**
	Rate (per 100,000 live births)			
All persons	20.5	17.4	7.9	7.3
Under 25	10.6	10.6	5.6	5.6
25-39	16.6	16.6	7.0	7.0
40 and over	175.7	81.9	44.1	25.2
• 40-44	82.6	82.6	26.4	26.4
• 45 and over	1,315.9	*	261.1	*
	Number			
All persons	777	658	301	277
Under 25	96	96	51	51
25-39	458	458	194	194
40 and over	223	104	56	32
• 40-44	97	97	31	31
• 45 and over	126	7	25	1

* Rate does not meet National Center for Health Statistics standards of reliability.

Table adapted from Maternal mortality in the United States: Changes in coding, publication, and data release, 2018.[35]

The CDC plans to retroactively recode maternal deaths for the period 2003-2017 using both the "2018 method", as well as the "pre-2003 method" (i.e. without referring to the pregnancy checkbox)[35], providing official values for MMR missing from this period. However, the official recommendation is that MMRs beginning 2018 should not be evaluated against those pre-2018 due to the diachronous implementation of the pregnancy check box on the death certificate.[35]

Several studies identified in the literature review adopted various ways to minimize impact of the pregnancy check box (Table 6). However, the study proposed in this thesis will focus on the time period after complete implementation of the pregnancy check box to avoid attribution errors.

Table 6. Summary of how pertinent literature review studies address pregnancy check box issue

Study Title	**How impact of pregnancy check box minimized**
The association between state-level abortion restrictions and maternal mortality in the United States, 1995-2017 [60]	Added pregnancy checkbox as a potential confounder. Per sensitivity analysis, no change in results.
State Abortion Policies and Maternal Death in the United States, 2015–2018 [7]	Applied 2018 coding method on 2015-2018 data for consistency

Texas – House Bill 2 (HB2) and Senate Bill 8 (SB8)

Some of the most restrictive abortion policies were implemented in Texas – House Bill 2 and Senate Bill 8. Although abortions were legal post *Roe v Wade*, this ruling was predicated upon the concept of patient privacy, rather than the legality of the procedure. Thus, *Roe v Wade* did not completely protect pregnant people's reproductive rights and access to abortions were restricted via various state laws, such as HB2 and SB8. In the years between 2013 and 2016 when HB2 was in effect, more than 50% of

clinics providing abortion services in Texas closed and the rate of abortions decreased by 13% within a year of HB2 being implemented.[66] Although HB2 was repealed in 2016, most clinics did not reopen.[28] The effect of those 3 years left an indelible negative consequence on abortion access in Texas.

In 2021, Texas passed Senate Bill 8, colloquially known as the "Texas Heartbeat Act". This law effectively banned abortion once the fetal heartbeat was detected at ~6 weeks gestation, except in maternal life threatening medical emergencies.[36] One unique aspect of SB8 was the allowance of private citizens to sue not just the provider(s) who performed the abortion, but anyone who assisted in the process (e.g. nurses, anesthesiologists, out of state providers performing abortion or person making out of state travel arrangements for pregnant patients).[36] Not only did SB8 reduce abortion access via decreasing the eligible gestation age, it created a culture of fear and uncertainty around obstetric interventions that could be deliberately misinterpreted as elective abortions. Therefore, providers were more likely to delay medical care leading to pregnancy termination until the clinical status of the pregnant person was unequivocally life-threatening. A small study (N=28) at two Texas hospitals found that delayed obstetric intervention at <22 weeks gestation resulted in serious maternal morbidity, almost doubling from 33% to 57%.[67] Unfortunately, 27 out of 28 patients experienced fetal or neonatal loss, highlighting how SB8 complicated maternal outcomes without supporting the life of the fetus.[67]

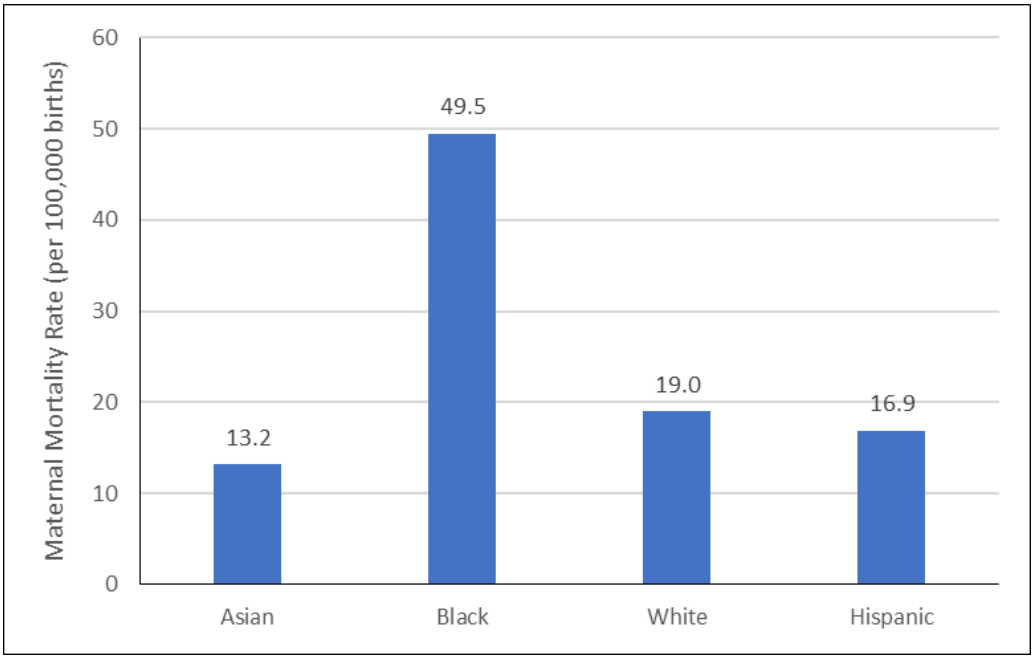
Even prior to *Dobbs v Jackson*, abortion policies in Texas and a few other states were already restrictive. As a result, the net reduction in abortion access may not differ

sufficiently to effect a change in MMR post *Dobbs* since those living in such restrictive states are already currently subjected to the increased risk of maternal mortality.[59] The study proposed in this thesis will assess any changes in maternal mortality caused by both absolute restrictiveness and overall net change in restrictiveness of state abortion policies.

Impact of Race/ Ethnicity

Previous research has established the disproportionate effect of race on maternal mortality ratio with non-Hispanic Black women experiencing between 2.5-4 times greater risk of death during pregnancy.[68,69] In 2022, the official CDC reported MMR for non-Hispanic Black women was 49.5 deaths per 100,000 live births, significantly higher that all other races (Figure 12).[3]

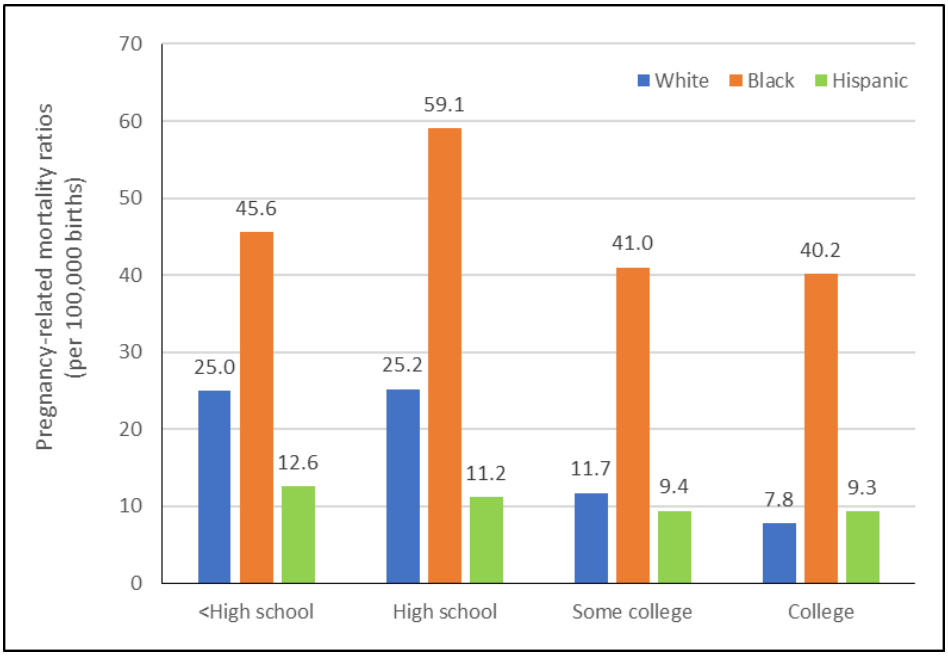
Figure 12. Maternal Mortality Rate, by race: United States, 2022



Adapted from Maternal Mortality Rates in the United States, 2022.[3]

Unfortunately, the impact of race on risk of maternal death persists even at higher education levels. It would be reasonable to presuppose that higher education increases health literacy, therefore reducing the risk of maternal death. However, one study came to the alarming conclusion that the ratio of college educated black maternal deaths to college educated white maternal deaths was greater than 5:1[4] (Figure 13). More surprisingly, this same study noted that college educated black maternal deaths were more common than high school white maternal deaths[4] (Figure 13).

Figure 13. Pregnancy Related Mortality Ratios in the US by race and education level, 2007-2016



Adapted from Maternal Mortality in the United States: A Primer.[4]

The study proposed in this thesis will include assessing the impact of race/ ethnicity on changes in maternal mortality caused by both absolute restrictiveness and overall net change in restrictiveness of state abortion policies.

Summary

Despite the growing body of literature identifying the association of reduced abortion access via state policies and maternal mortality, due to the currency of the *Dobbs v Jackson* ruling in June 2022, there is a paucity of data on the impact of *Dobbs* on maternal mortality. Therefore, this study seeks to obtain data as outlined in the next chapter to help address this research gap.

CHAPTER THREE - METHODS

Study Design

The proposed study will be a prospective ecological analysis of maternal mortality metrics in the United States from 2018 to 2027. The goal is to determine if there is an association between increasingly restrictive abortion policies enacted after the *Dobbs v Jackson* ruling, and maternal mortality.

The study period 2018 to 2027 is selected to address the following research gaps/ limitations noted in previous studies:

- Diachronous implementation of pregnancy check box: In 2018, all fifty states implemented a pregnancy check box on the death certificate.[35] This, and use of the "2018 method" will reduce variability in the maternal mortality metrics obtained/ reported by the CDC.
- Two distinct time periods representing pre and post *Dobbs*: The US Supreme Court ruled on *Dobbs v Jackson* on June 24, 2022. In this study, pre-*Dobbs* will be defined as 2018 to 2022, while post-*Dobbs* will encompass 2023 to 2027. This allows additional time for potential impact of state level abortion policy changes to disseminate through the legal and healthcare systems. Additionally, since maternal death is an infrequent event, it may require aggregation over several years to support data analysis.
- Exploring ramifications of maternal mortality metrics based on live births vs number of pregnancies: As previously noted, the internationally accepted definition for maternal mortality ratio (MMR) is calculated with respect to total number of live

births. This is the consistent metric used by the WHO to compare MMRs between countries. However, Stevenson et. al. makes a compelling argument that since all pregnancies have the potential to result in maternal death, MMR should be determined based on the total number of pregnancies (i.e. summation of live births, abortions, and fetal losses).[59] Conceptually, when comparing MMRs between abortion protective versus abortion restrictive states, including the number of abortions in the denominator could potentially decrease MMRs for abortion protective states. Therefore, both MMR (i.e. only live births in denominator) and an "adjusted MMR", aMMR, (i.e. all pregnancies in denominator) will be calculated in this study.

Measures and Data Collection

Abortion Policy Composite Index (APCI)

This study will use a similar approach as Vilda et. al.[7] and calculate abortion policy composite indices to quantify the overall abortion policy restrictiveness in each state. Use of an index acknowledges the multitude of ways that can be employed to reduce abortion access. The proposed index will encompass ten state-level policies (Table 7). A value of "0" will be assigned if the policy is not in effect. The maximum index value is 10.5. Data on the status of these policies for each state will be acquired from publicly accessible databases curated by the Guttmacher Institute or the Kaiser Family Foundation. Reliability of the policies used to determine the index will be calculated using Cronbach's alpha. Selection of policies will be reconsidered if $\alpha<0.7$ or $\alpha>0.95$.

Table 7. State-level policies used to determine Abortion Policy Composite Index (APCI) and corresponding designated coding

State level abortion policy	Designated coding
Gestational age limits	
• No gestational ban	0
• 24-26 week ban	1
• 6-23 week ban	1.5
• Total abortion ban	2
State mandated counseling prior to abortion	1
Compulsory delay between counseling and abortion procedure	1
Compulsory ultrasound prior to abortion	1
Requiring only physicians to perform abortions	1
Private health insurance plans that exclude abortions	1
Preclude use of public funding (e.g. state Medicaid) to pay for abortion	1
Parental notification and/or consent for unmarried minors seeking abortion	0.5
Medication abortion in-person requirement	1
Excessive facility requirements where abortions are performed	1

For each state, the annual APCIs will be tallied. Following this, pre-*Dobbs* (i.e. 2018-2022) and post-*Dobbs* (i.e. 2023-2027) APCIs will be determined by taking the average of the appropriate annual indices within each time period. The net change in APCI pre and post *Dobbs* (i.e. ΔAPCI per state) will then be calculated.

Additional Study Variables

The primary outcome variables in this proposed study are state level MM, MMR, aMMR, ΔMMR, and ΔaMMR. These latter variables represent the additional number of maternal deaths (per 100,000 births for MMR or per 100,000 pregnancies for adjusted MMR) resulting from the change in abortion restrictiveness post *Dobbs* (reflected in state ΔAPCI).

Moreover, since 2020 data from maternal mortality review committees in 38 states indicated that 26.9% of pregnancy-related deaths occurred 43-365 days postpartum (i.e. LMM)[70], the following secondary variables will also be studied - late maternal

mortality (LMM) and total maternal mortality (TMM). Including LMM and TMM within the scope of this study allows more comprehensive assessment of the impact of restrictive abortion policies on maternal health.

Annual data from 2018-2027 for MM and MMR per state will be obtained from the National Vital Statistics System (NVSS), while annual data from 2018-2027 for LMM and TMM per state will be obtained from the Pregnancy Mortality Surveillance System (PMSS). To determine the total number of pregnancies, the number of live births and the number of fetal deaths (by state) will be obtained from NVSS and the number of abortions (by state) will be obtained from the Guttmacher Institute. Reporting of abortion data by states to the CDC is voluntary and the CDC 2021 abortion surveillance report excluded four reporting areas (California, Maryland, New Hampshire and New Jersey).[19] These four areas collectively accounted for approximately 25% of all abortion occurrences in 2020.[37] Therefore, abortion occurrence data from the Guttmacher institute is preferred since this database consistently reports data from all fifty states.[37] The annual aMMR from 2018-2027 per state will then be calculated.

Additionally, the following will be calculated for each state and stratified by race if demographic data is available:

(a) Pre-*Dobbs* maternal mortality metrics (2018-2022)

- MM (pre-*Dobbs*) = sum of all maternal deaths in 2018-2022
- MMR (pre-*Dobbs*) = MM (pre-*Dobbs*) / sum of all live births in 2018-2022, reported per 100,000 live births

- aMMR (pre-*Dobbs*) = MM (pre-*Dobbs*) / sum of all pregnancies in 2018-2022, reported per 100,000 pregnancies

(b) Post-*Dobbs* maternal mortality metrics (2023-2027): MM (post-*Dobbs*), MMR (post-*Dobbs*), aMMR (post-*Dobbs*)

(c) Net change in MM, MMR and aMMR pre and post *Dobbs* (i.e. ΔMM, ΔMMR and ΔaMMR per state)

Data Analysis

The following will be analyzed for possible associations: (a) MM (pre-*Dobbs*) and MMR (pre-*Dobbs*) vs APCI (pre-*Dobbs*); (b) MM (post-*Dobbs*) and MMR (post-*Dobbs*) vs APCI (post-*Dobbs*); (c) ΔMMR vs ΔAPCI; and (d) ΔaMMR vs ΔAPCI.

Covariates

Potential confounders (Table 8) will be accounted for using polynomial regression in this study. All data will be obtained from the US Census Bureau, American Community Survey unless otherwise stated.

Table 8. Covariates in study and corresponding measures

Covariates	Corresponding Measures
State poverty levels	*Percentage of households living below the federal poverty level[70]
State unemployment levels	*Percentage of civilian workforce ages 16-64 that is unemployed[70]
Education level	*Percentage of adults ≥65 years with college degree[70]
Impact of race on MMR[3,68,69]	females of reproductive age (15-44 years) stratified by race, data from US Census Bureau, Population Division
Impact of age on MMR[3]	Percentage of births to women ≥40 years, data from National Center for Health Statistics natality data files

Note: * indicates measures will be obtained from US Census Bureau, American Community Survey

Timeline and Resources

This study may start immediately upon approval but will not be complete until 2027 data is available. It is anticipated that one study coordinator, 2 student workers and 1 data analyst will be sufficient to complete the data mining, perform statistical analysis and write the final report. A laptop with the appropriate statistical software will be needed.

Institutional Review Board

This proposed study uses data that is publicly available and de-identified. As such, it is exempt from review by the Boston Medical Center and Boston University Medical Campus Institutional Review Board.

CHAPTER FOUR - CONCLUSION

Discussion

In the two years since the US Supreme Court ruled in *Dobbs v Jackson* and overturned *Roe v Wade*, there remains a scarcity of data around how subsequent changes in abortion policy have impacted maternal mortality. Part of this can be attributed to the flurry of legislation increasing abortion restrictiveness immediately following the ruling[71] and the reflexive response from pro-reproductive health advocacy groups, creating a complicated environment that healthcare providers must navigate in abortion restrictive states. The prevailing opinion is that states with more restrictive abortion policies will experience increased maternal mortality post *Dobbs*.[28,72,73] This opinion is directionally corroborated by pre-*Dobbs* research [4,7,60,74,75] and post-*Dobbs* models.[59] This study is designed to test the hypothesis that states with more restrictive abortion policies post *Dobbs v Jackson* will experience an increase in maternal mortality.

A strength of the proposed study is the quantification of abortion restrictiveness via an abortion policy composite index (APCI). Moreover, it considers how a change in this index may impact maternal mortality metrics. This study recognizes that maternal mortality metrics may not be statistically negatively impacted if the overall change in restrictiveness index did not increase substantially between pre and post *Dobbs* periods.

Another advantage of this study is that both MMR and adjusted MMRs will be used to evaluate the possible association between abortion restrictiveness and maternal mortality. MMR allows for comparison with other studies that adopt the universally accepted WHO definition of MMR, while the use of an adjusted MMR recognizes a risk

of death in all pregnancies, not just those that result in live births.[59] It will also be interesting to evaluate a possible relation between MMR and adjusted MMR.

Limitations

The main weakness of this study, similar to others in this field, is that only an association, not causality, can be established between abortion restrictiveness and maternal mortality. Despite this limitation, data from this study will still offer valuable insight into the comparative utility of MMR and adjusted MMR and how changes in abortion restrictiveness pre and post *Dobbs* may affect maternal mortality.

Another limitation of this study, applicable to all studies that adopt the WHO definition of MMR, is the accurate designation of maternal mortality related ICD 10 codes upon review of the death certificate. The element of human error is unavoidable even if it can be mitigated with experience and appropriate training. Hopefully, this limitation will be of little significance since all states will have implemented both the pregnancy check box on death certificates and consistent use of the "2018 method" for coding maternal deaths prior to the study period (2018-2027).[35]

An uncontrolled factor in this study is the effect of coronavirus disease 2019 (COVID-19) pandemic on maternal mortality. A substantial spike in the MMR from 23.8 to 32.9 maternal deaths per 100,000 live births occurred between 2020-2021[3], coinciding with the initial widespread COVID-19 outbreak within the US (Figure 2). An international cohort study from March to October 2020 conducted in 18 countries concluded that pregnant women with COVID-19 experienced an elevated maternal mortality risk ratio of 22.3 compared to pregnant women who were uninfected.[76]

Analysis of a cohort study conducted in the US (N=2,578,095) also yielded an elevated adjusted maternal mortality risk ratio (13.91) for pregnant patients infected with COVID-19 at the time of delivery.[77] A report released in 2022 by the US Government Accountability Office went as far as attributing most of the increases in maternal mortality in 2020, and all of the increases in 2021, to COVID-19.[78] However, it is difficult to adjust for this confounder since the impact of COVID-19 is intricately intertwined with state policies (e.g. mask wearing, vaccine mandate)[79] and social determinants of health (e.g. structural racism, access to healthcare, education, employment).[80] Additionally, while COVID-19 may have resulted in the dramatic increase in MMR between 2020-2021, it does not explain the persistent and gradual increase in MMR since the 1990s (Figure 2).

Summary and Public Health Significance

The proposed study will shed light on the association of maternal mortality metrics stemming from increased abortion restrictiveness due to the *Dobbs v Jackson* ruling. By contributing to existing research in this field, the study has the potential to drive evidence-based policy changes to reduce maternal mortality via increasing abortion access. While this may be a difficult, protracted political and legal battle against religious and/or conservative pro-life advocacy groups/ state legislatures, the Pew Research Center reports that in 2024, 63% of US adults support legal abortion.[81] The disconnect between voters and state legislature was clearly highlighted when voters in Kansas and Ohio elected to protect abortion rights in their state constitutions despite increasing abortion

restrictiveness within the state.[82,83] Continued education of the voting public is a critical step in influencing changes in future abortion related policies.

Currently, a large-scale study titled “Legal Epidemiology of Abortion (LEAP)” is being conducted by ANSIRH, the same organization that spearheaded the influential “Turnaway Study”.[84] LEAP will examine how state level abortion policies negatively impact maternal and child health. It will also assess any disproportionate impact of these policies on various populations.[84] The anticipated findings will likely have important implications for future policies and practices.

It is essential to recognize that abortion access is just one part of a multifaceted and complicated effort to reduce maternal mortality. Progress is also needed on other fronts, including ensuring high quality prenatal care, consistent postpartum clinical follow-up, affordable medical insurance coverage, and childcare support. In 2018, the Public Health Service Act was modified to improve financial support of CDC maternal mortality monitoring initiatives.[85] Additionally, the Healthy People 2030 program aims to reduce MMR to 15.7 per 100,000 births.[86] While the overarching aim is to reduce maternal mortality, every maternal death represents a personal and irrevocable loss of someone’s mother, someone’s child and conceivably someone’s partner.

BIBLIOGRAPHY

1. Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. Geneva: World Health Organization. Published 2023. Accessed June 11, 2024. https://www.who.int/publications-detail-redirect/9789240068759

2. MacDorman MF, Thoma M, Declercq E. Improving US maternal mortality reporting by analyzing literal text on death certificates, United States, 2016–2017. Spradley FT, ed. *PLOS ONE*. 2020;15(10):e0240701. doi:10.1371/journal.pone.0240701

3. Hoyert DL. Maternal Mortality Rates in the United States, 2022. *National Vital Statistics Report* 2024;69(2). https://www.cdc.gov/nchs/data/hestat/maternal-mortality/2022/maternal-mortality-rates-2022.pdf

4. Declercq E, Zephyrin L. Maternal Mortality in the United States: A Primer. Commonwealth Fund. doi:10.26099/ta1q-mw24

5. Stevenson AJ, Root L, Menken J. *The Maternal Mortality Consequences of Losing Abortion Access*. SocArXiv; 2022. doi:10.31235/osf.io/7g29k

6. Hoyert DL. Maternal Mortality Rates in the United States, 2021. CDC - National Center for Health Statistics. Published March 16, 2023. Accessed July 17, 2023. https://www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm

7. Vilda D, Wallace ME, Daniel C, Evans MG, Stoecker C, Theall KP. State Abortion Policies and Maternal Death in the United States, 2015–2018. *American Journal of Public Health*. 2021;111(9):1696-1704. doi:10.2105/AJPH.2021.306396

8. MacDorman MF, Declercq E. The failure of United States maternal mortality reporting and its impact on women's lives. *Birth*. 2018;45(2):105-108. doi:10.1111/birt.12333

9. Mingst K. Group of Eight. Britannica. Published May 20, 2024. Accessed June 24, 2024. https://www.britannica.com/topic/Group-of-Eight

10. Declercq E, Thoma M. Measuring US Maternal Mortality. *Journal of the American Medical Association*. 2023;330(18):1731. doi:10.1001/jama.2023.19945

11. Sondik EJ, Madans JH, Sadagursky MH, et al. Maternal Mortality and Related Concepts. *National Center of Health Statistics. Vital and Health Statistics*. 2007;3(33). https://www.cdc.gov/nchs/data/series/sr_03/sr03_033.pdf

12. *California-Pregnancy Mortality Surveillance System Surveillance Report: Pregnancy-Related Deaths in California, 20082016.* Sacramento: California Department of Public Health, Maternal, Child and Adolescent Health Division; 2021. Accessed June 12, 2024. https://www.cdph.ca.gov/Programs/CFH/DMCAH/surveillance/CDPH%20Document%20Library/CA-PMSS/CA-PMSS-Surveillance-Report-2008-2016.pdf

13. Raymond EG, Grimes DA. The Comparative Safety of Legal Induced Abortion and Childbirth in the United States: *Obstetrics and Gynecol*ogy. 2012;119(2, Part 1):215-219. doi:10.1097/AOG.0b013e31823fe923

14. Stevenson A, Raymond E, Grossman D. O04 - COMPARING MORTALITY RISK OF INDUCED ABORTION WITH MORTALITY RISK OF STAYING PREGNANT. *Contraception*. 2023;127:110150. doi:10.1016/j.contraception.2023.110150

15. Abortion care guideline: executive summary. Geneva: World Health Organization. Published 2022. Accessed June 12, 2024. https://www.who.int/publications-detail-redirect/9789240045163

16. Wall LL, Yemane A. Infectious Complications of Abortion. *Open Forum Infectious Diseases*. 2022;9(11):ofac553. doi:10.1093/ofid/ofac553

17. Stubblefield P, Grimes DA, Borgatta L, Paul M, Creinin MD, Lichtenberg S. *Management of Unintended and Abnormal Pregnancy: Comprehensive Abortion Care*. 1st ed. John Wiley & Sons, Incorporated

18. Autry BM, Wadhwa R. Mifepristone. In: *StatPearls [Internet]*. StatPearls Publishing; 2024. Accessed June 15, 2024. http://www.ncbi.nlm.nih.gov/books/NBK557612/

19. Kortsmit K, Nguyen AT, Mandel MG, et al. Abortion Surveillance — United States, 2021. *Morbidity and Mortality Weekly Report Surveillance Summaries*. 2023;72(9):1-29. doi:http://dx.doi.org/10.15585/mmwr.ss7209a1

20. Jones RK, Kirstein M, Philbin J. Abortion incidence and service availability in the United States, 2020. *Perspectives on Sexual and Reproductive Health*. 2022;54(4):128-141. doi:10.1363/psrh.12215

21. Farin SM, Hoehn-Velasco L, Pesko M. The Impact of Legal Abortion on Maternal Mortality. *IZA Institute of Labor Economics*. Published online October 2022. Accessed July 7, 2023. https://www.iza.org/publications/dp/15657/the-impact-of-legal-abortion-on-maternal-mortality

22. *Health, United States, 2011: With Special Feature on Socioeconomic Status and Health*. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2012. https://www.cdc.gov/nchs/data/hus/hus11.pdf

23. Barfield WD, Besera G, Cox S, et al. From Data to Action: CDC's Public Health Surveillance for Women, Infants and Children (second edition). Published online 2020. https://www.cdc.gov/reproductive-health/media/pdfs/data-to-action/Data-To-Action_508.pdf

24. Finer LB, Frohwirth LF, Dauphinee LA, Singh S, Moore AM. Reasons U.S. women have abortions: quantitative and qualitative perspectives. *Perspectives on Sexual and Reproductive Health*. 2005;37(3):110-118. doi:10.1363/psrh.37.110.05

25. Biggs MA, Gould H, Foster DG. Understanding why women seek abortions in the US. *BMC Women's Health*. 2013;13(1):29. doi:10.1186/1472-6874-13-29

26. CDC. About Teen Pregnancy. Reproductive Health. Published May 20, 2024. Accessed June 15, 2024. https://www-cdc-gov.ezproxy.bu.edu/reproductive-health/teen-pregnancy/index.html

27. Crear-Perry J, Hassan A, Daniel S. Advancing Birth Equity in a Post-Dobbs US. *Journal of the American Medical Association*. 2022;328(17):1689-1690. doi:10.1001/jama.2022.19468

28. Thaxton L, Gonzaga MI, Tristan S. Abortion Policy: Legal, Clinical, and Medical Education Considerations. *Clinical Obstetrics and Gynecology*. 2023;66(4):759-772. doi:10.1097/GRF.0000000000000824

29. Coble YD Jr, Estes EH Jr, Head CA, et al. Induced Termination of Pregnancy Before and After Roe v Wade: Trends in the Mortality and Morbidity of Women. *Journal of the American Medical Association*. 1992;268(22):3231-3239. doi:10.1001/jama.1992.03490220075032

30. MacDorman M, Declercq E, Cabral H, Morton CH. Recent Increases in the U.S. Maternal Mortality Rate: Disentangling Trends From Measurement Issues. *Obstetrics and Gynecology*. 2016;128:447-455. doi:10.1097/AOG.0000000000001556

31. McKinley Jr JC. Texas Passes Bill to Require Sonograms Before Abortions. *The New York Times*. https://www.nytimes.com/2011/05/06/us/politics/06sonogram.html. Published May 6, 2011. Accessed June 12, 2024.

32. What are TRAP Laws? Planned Parenthood. Accessed June 12, 2024. https://www.plannedparenthoodaction.org/issues/abortion/types-attacks/trap-laws

33. Whole Woman's Health v. Hellerstedt. Center for Reproductive Rights. Accessed June 15, 2024. https://reproductiverights.org/case/whole-womans-health-v-hellerstedt/

34. Johnston E, Strahan AE, Joski P, Dunlop A, Adams EK. Impacts of the Affordable Care Act's Medicaid Expansion on Women of Reproductive Age: Differences by Parental Status and State Policies. *Women's Health Issues*. 2018;28(2):122-129. doi:10.1016/j.whi.2017.11.005

35. Hoyert DL, Minino AM. Maternal mortality in the United States: Changes in coding, publication, and data release, 2018. *National Vital Statistics Reports*. 2020;69(2). Accessed June 10, 2024. https://www-cdc-gov.ezproxy.bu.edu/nchs/data/nvsr/nvsr69/nvsr69-02-508.pdf

36. Arey W, Lerma K, Beasley A, Harper L, Moayedi G, White K. A Preview of the Dangerous Future of Abortion Bans — Texas Senate Bill 8. *The New England Journal of Medicine*. 2022;387(5):388-390. doi:10.1056/NEJMp2207423

37. Maddow-Zimet I, Philbin J, DoCampo I, Jones R. Monthly Abortion Provision Study. Published online March 19, 2024. https://osf.io/k4x7t/

38. *#WeCount Report April to March 2023 Findings*. Society of Family Planning; 2023. doi:10.46621/XBAZ6145

39. *#WeCount Report, April 2022 to December 2023*. Society of Family Planning; 2024. doi:10.46621/970371hxrbsk

40. State Bans on Abortion Throughout Pregnancy. Guttmacher Institute. Published May 1, 2024. Accessed June 12, 2024. https://www-guttmacher-org.ezproxy.bu.edu/state-policy/explore/state-policies-abortion-bans

41. MMR-2018-2021-State-Data.pdf. Accessed July 17, 2023. https://www.cdc.gov/nchs/maternal-mortality/MMR-2018-2021-State-Data.pdf

42. Nash E. State Abortion Policy Landscape: From Hostile to Supportive. Guttmacher Institute. Published December 30, 2020. Accessed June 25, 2024. https://www.guttmacher.org/article/2019/08/state-abortion-policy-landscape-hostile-supportive

43. Interactive Map: US Abortion Policies and Access After Roe. Guttmacher Institute. Published June 7, 2024. Accessed June 12, 2024. https://states-guttmacher-org.ezproxy.bu.edu/policies/

44. Maternal deaths and mortality rates: Each state, the District of Columbia, United States, 2018-2022. Accessed June 19, 2024. https://www.cdc.gov/nchs/maternal-mortality/mmr-2018-2022-state-data.pdf

45. Despite Bans, Number of Abortions in the United States Increased in 2023. Guttmacher Institute. Published March 2024. Accessed June 12, 2024. https://www.guttmacher.org/2024/03/despite-bans-number-abortions-united-states-increased-2023

46. Jones RK. An estimate of lifetime incidence of abortion in the United States using the 2021–2022 Abortion Patient Survey. *Contraception*. 2024;135:110445. doi:10.1016/j.contraception.2024.110445

47. Mason CN, Poyatzis G. IWPR Reproductive Rights Index. *Institute for Women's Policy Research*. 2022;(IWPR #B390). Accessed June 10, 2024. https://iwpr.org/wp-content/uploads/2022/07/Reproductive-Rights-Index-2022_FINAL_website.pdf

48. Biggs MA, Upadhyay UD, McCulloch CE, Foster DG. Women's Mental Health and Well-being 5 Years After Receiving or Being Denied an Abortion: A Prospective, Longitudinal Cohort Study. *JAMA Psychiatry*. 2017;74(2):169-178. doi:10.1001/jamapsychiatry.2016.3478

49. The Turnaway Study. University of California San Francisco - Advancing New Standards in Reproductive Health. Accessed June 17, 2024. https://www.ansirh.org/research/ongoing/turnaway-study

50. Ralph LJ, Foster DG, Rocca CH. Comparing Prospective and Retrospective Reports of Pregnancy Intention in a Longitudinal Cohort of U.S. Women. *Perspectives on Sexual and Reproductive Health*. 2020;52(1):39-48. doi:10.1363/psrh.12134

51. Gerdts C, Dobkin L, Foster DG, Schwarz EB. Side Effects, Physical Health Consequences, and Mortality Associated with Abortion and Birth after an Unwanted Pregnancy. *Women's Health Issues*. 2016;26(1):55-59. doi:10.1016/j.whi.2015.10.001

52. Ralph LJ, Schwarz EB, Grossman D, Foster DG. Self-reported Physical Health of Women Who Did and Did Not Terminate Pregnancy After Seeking Abortion Services: A Cohort Study. *Annals of Internal Medicine*. 2019;171(4):238-247. doi:10.7326/M18-1666

53. Roberts SC, Biggs MA, Chibber KS, Gould H, Rocca CH, Foster DG. Risk of violence from the man involved in the pregnancy after receiving or being denied an abortion. *BMC Medicine*. 2014;12(1):144. doi:10.1186/s12916-014-0144-z

54. Foster DG, Biggs MA, Ralph L, Gerdts C, Roberts S, Glymour MM. Socioeconomic Outcomes of Women Who Receive and Women Who Are Denied Wanted Abortions in the United States. *American Journal of Public Health*. 2018;108(3):407-413. doi:10.2105/AJPH.2017.304247

55. Foster DG, Raifman SE, Gipson JD, Rocca CH, Biggs MA. Effects of Carrying an Unwanted Pregnancy to Term on Women's Existing Children. *The Journal of Pediatrics*. 2019;205:183-189.e1. doi:10.1016/j.jpeds.2018.09.026

56. Foster DG, Biggs MA, Raifman S, Gipson J, Kimport K, Rocca CH. Comparison of Health, Development, Maternal Bonding, and Poverty Among Children Born After Denial of Abortion vs After Pregnancies Subsequent to an Abortion. *JAMA Pediatrics*. 2018;172(11):1053-1060. doi:10.1001/jamapediatrics.2018.1785

57. Sisson G, Ralph L, Gould H, Foster DG. Adoption Decision Making among Women Seeking Abortion. *Women's Health Issues*. 2017;27(2):136-144. doi:10.1016/j.whi.2016.11.007

58. In: *Merriam-Webster.Com Dictionary*. Accessed June 17, 2024. https://www.merriam-webster.com/dictionary/ceteris%20paribus

59. Stevenson AJ. The Pregnancy-Related Mortality Impact of a Total Abortion Ban in the United States: A Research Note on Increased Deaths Due to Remaining Pregnant. *Demography*. 2021;58(6):2019-2028. doi:10.1215/00703370-9585908

60. Addante AN, Eisenberg DL, Valentine MC, Leonard J, Maddox KEJ, Hoofnagle MH. The association between state-level abortion restrictions and maternal mortality in the United States, 1995-2017. *Contraception*. 2021;104(5):496-501. doi:10.1016/j.contraception.2021.03.018

61. Wallace ME, Evans MG, Theall K. The Status of Women's Reproductive Rights and Adverse Birth Outcomes. *Women's Health Issues*. 2017;27(2):121-128. doi:10.1016/j.whi.2016.12.013

62. Thompson TA, Seymour J. Evaluating priorities: measuring women's and children's health and well-being against abortion restrictions in the states. Research Report. Published online June 2017. https://www.ibisreproductivehealth.org/sites/default/files/files/publications/Evaluating%20Priorities%20August%202017.pdf

63. Latt SM, Milner A, Kavanagh A. Abortion laws reform may reduce maternal mortality: an ecological study in 162 countries. *BMC Women's Health*. 2019;19:1. doi:10.1186/s12905-018-0705-y

64. Rossen LM, Womack LS, Hoyert DL, Anderson RN, Uddin SFG. The Impact of the Pregnancy Checkbox and Misclassification on Maternal Mortality Trends in the United States, 1999-2017. *National Center for Health Statistics Vital and Health Statistics 3*. 2020;(44):1-61.

65. Baeva S, Saxton DL, Ruggiero K, et al. Identifying Maternal Deaths in Texas Using an Enhanced Method, 2012. *Obstetrics and Gynecology*. 2018;131(5):762. doi:10.1097/AOG.0000000000002565

66. Jones RK, Jerman J. Abortion Incidence and Service Availability In the United States, 2014. *Perspectives on Sexual and Reproductive Health*. 2017;49(1):17-27. doi:10.1363/psrh.12015

67. Nambiar A, Patel S, Santiago-Munoz P, Spong CY, Nelson DB. Maternal morbidity and fetal outcomes among pregnant women at 22 weeks' gestation or less with complications in 2 Texas hospitals after legislation on abortion. *American Journal of Obstetrics and Gynecology*. 2022;227(4):648-650.e1. doi:10.1016/j.ajog.2022.06.060

68. Joseph KS, Boutin A, Lisonkova S, et al. Maternal Mortality in the United States: Recent Trends, Current Status, and Future Considerations. *Obstetric Anesthesia Digest*. 2021;41(3):110-110. doi:10.1097/01.aoa.0000765988.46176.ac

69. Collier A ris Y, Molina RL. Maternal Mortality in the United States: Updates on Trends, Causes, and Solutions. *Neoreviews*. 2019;20(10):e561-e574. doi:10.1542/neo.20-10-e561

70. Health Measures. America's Health Rankings. Accessed June 25, 2024. https://www.americashealthrankings.org/explore/measures

71. Nash E, Ephross P. State Policy Trends 2022: In a Devastating Year, US Supreme Court's Decision to Overturn Roe Leads to Bans, Confusion and Chaos. Guttmacher Institute. Published December 2022. https://www.guttmacher.org/2022/12/state-policy-trends-2022-devastating-year-us-supreme-courts-decision-overturn-roe-leads

72. Sidik SM. The effects of overturning Roe v. Wade in seven simple charts. *Nature*. 2022;608(7922):254-257. doi:10.1038/d41586-022-02139-3

73. Declercq E, Barnard-Mayers R, Zephyrin LC, Johnson K. The U.S. Maternal Health Divide: The Limited Maternal Health Services and Worse Outcomes of States Proposing New Abortion Restrictions. The Commonwealth Fund. doi:10.26099/z7dz-8211

74. Hawkins SS, Ghiani M, Harper S, Baum CF, Kaufman JS. Impact of State-Level Changes on Maternal Mortality: A Population-Based, Quasi-Experimental Study. *American Journal of Preventive Medicine*. 2020;58(2):165-174. doi:10.1016/j.amepre.2019.09.012

75. Williams AM, Chaturvedi R, Pollalis I, Ibarra-Cobarru J, Aaronson JA, White RS. Associations between state policies, race, ethnicity and rurality, and maternal mortality and morbidity following the United States Supreme Court Dobbs v. Jackson

Women's Health Organization ruling. *British Journal of Anaesthesia*. 2022;129(6):e145-e147. doi:10.1016/j.bja.2022.08.016

76. Villar J, Ariff S, Gunier RB, et al. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. *JAMA Pediatrics*. 2021;175(8):817-826. doi:10.1001/jamapediatrics.2021.1050

77. Matsuo K, Green JM, Herrman SA, Mandelbaum RS, Ouzounian JG. Severe Maternal Morbidity and Mortality of Pregnant Patients With COVID-19 Infection During the Early Pandemic Period in the US. *JAMA Network Open*. 2023;6(4):e237149. doi:10.1001/jamanetworkopen.2023.7149

78. *Maternal Health: Outcomes Worsened and Disparities Persisted During the Pandemic*. U.S. Government Accountability Office; 2022. Accessed June 24, 2024. https://www.gao.gov/products/gao-23-105871

79. Williams AM, Chaturvedi R, Abramovitz S, White RS. Associations between COVID-19 State Policies and Maternal Mortality and Morbidity. *American Journal of Perinatology*. 2023;41:e2622-e2624. doi:10.1055/a-2135-6704

80. Tanne JH. Covid-19: US maternal mortality rose during pandemic. *BMJ: British Medical Journal*. 2023;380:p659. doi:10.1136/bmj.p659

81. Public Opinion on Abortion. Pew Research Center. Published May 13, 2024. Accessed June 22, 2024. https://www.pewresearch.org/religion/fact-sheet/public-opinion-on-abortion/

82. Doan A. The Kansas abortion vote shows the loudest voices in this debate are not representative ones. *BMJ: British Medical Journal*. Published online August 16, 2022:o2024. doi:10.1136/bmj.o2024

83. Ohio Issue 1 Election Results: Establish a Constitutional Right to Abortion. The New York Times. Published November 7, 2023. Accessed June 22, 2024. https://www.nytimes.com/interactive/2023/11/07/us/elections/results-ohio-issue-1-abortion-rights.html

84. Legal Epidemiology of Abortion Policies (LEAP) Study. University of California San Francisco - Advancing New Standards in Reproductive Health. Accessed June 22, 2024. https://www.ansirh.org/research/ongoing/legal-epidemiology-abortion-policies-leap-study

85. Verma N, Shainker SA. Maternal mortality, abortion access, and optimizing care in an increasingly restrictive United States: A review of the current climate. *Seminars in Perinatology*. 2020;44(5):151269. doi:10.1016/j.semperi.2020.151269

86. Reduce maternal deaths — MICH-04 - Healthy People 2030 | health.gov. Accessed June 11, 2024. https://health.gov/healthypeople/objectives-and-data/browse-objectives/pregnancy-and-childbirth/reduce-maternal-deaths-mich-04