5-2024

Socioecological factors associated with the timing of prenatal care initiation in Kentucky and beyond: An exploratory study.

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SOCIOECOLOGICAL FACTORS ASSOCIATED WITH THE TIMING OF PRENATAL CARE INITIATION IN KENTUCKY AND BEYOND: AN EXPLORATORY STUDY

By

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A Dissertation
Submitted to the Faculty of the
School of Public Health and Information Sciences of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy in Public Health Sciences

Department of Health Management and Systems Sciences
University of Louisville
Louisville, Kentucky

May 2024

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A Dissertation Approved on

April 15, 2024

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DEDICATION

For my grandfather, who spent countless hours helping me with my high school geometry homework to no avail. I wish he could see me now.

For Luke and Annie. I hope you always remember that you can do hard things.

ACKNOWLEDGEMENTS

I could fill up the pages of this dissertation with acknowledgements for everyone who has supported me in my journey to this point. I cannot possibly name everyone, but I hope you all know how appreciated and important you are in my life. I want to acknowledge and thank the members of my dissertation committee for their guidance, mentorship, and friendship. Thank you to Dr. Liza Creel for encouraging me to pursue my research interests and giving me opportunities to do so. Thank you to Dr. Bridget Basile Ibrahim for answering my email in 2020. I am so happy that we connected and became fast collaborators and friends. Thank you to Dr. Bert Little who has provided me with support and guidance throughout my time at UofL. Thank you to Sue Kendig, whom I've known for many years, and who knows everyone. I miss our coffee dates and your energy and passion for all that you do and thank you for being a part of this journey with me. I want to give special thanks to Dr. Seyed Karimi, whose mentorship has greatly improved my scholarship and to whom I owe much appreciation for spending so much time supporting me throughout this process. I cannot thank my committee members enough for the time, mentorship, and support (academic and mental!) that you have all given me over the last few years. I could not have done this without each of you.

Finally, thank you to my friends and family, whom I love dearly, and who will never have to ask me again, "Are you *still* in school?"

This is it, you guys. I did it!

ABSTRACT

SOCIOECOLOGICAL FACTORS ASSOCIATED WITH THE TIMING OF PRENATAL CARE INITIATION IN KENTUCKY AND BEYOND: AN EXPLORATORY STUDY

Melissa B. Eggen

April 15, 2024

OBJECTIVES: Early prenatal care is initiated in the first twelve weeks of pregnancy and is a known contributor to improved short- and long-term outcomes for women and infants. Despite its known benefits, many women do not initiate early prenatal care. The purpose of this dissertation was to explore the socioecological factors associated with the timing of prenatal care initiation in the United States and in Kentucky.

METHODS: Chapter Two of this dissertation used a scoping review methodology to identify barriers and facilitators related to first-trimester prenatal care initiation among women in the United States. Chapter Three of this dissertation used Phase 8 Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS) data in a cross-sectional analysis to identify factors associated with early prenatal care initiation among women in Kentucky. A linear and logistic regression were used to examine the relationship between early prenatal care and intrapersonal factors such as maternal race, education, and pregnancy intention. Chapter Four of this dissertation used the Phase 8 Kentucky PRAMS data (2017-2020) in a quasi-experimental regression discontinuity design to assess the impact of COVID-19 on the timing of prenatal care initiation among women in Kentucky. The Socioecological Model (SEM) was used as the guiding framework for all three dissertation papers.

RESULTS: Early prenatal care initiation was associated with factors in the intrapersonal, interpersonal, and societal/environmental domains of the SEM. Early initiation was positively associated with intended pregnancy, pre-conception health insurance, prenatal care health insurance, higher levels of maternal education, and higher household income. The COVID-19 pandemic, an environmental domain factor of the SEM, was associated with a nearly 2-week delay in the timing of prenatal care initiation among women who conceived in the months immediately preceding the start of the pandemic.

CONCLUSIONS: The timing of prenatal care initiation is influenced by a multitude of interdependent factors in the intrapersonal, interpersonal, and environmental domains of the SEM. This dissertation highlights the need for holistic policy and practice solutions that can facilitate earlier entry to prenatal care and improve outcomes for women and infants.

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CHAPTER ONE: INTRODUCTION

1.0 Background

In the United States, women die during childbirth and in the postpartum period at a rate three times higher than that of other high-income, developed countries (Gunja et al., 2022). In 2022, The Commonwealth Fund reported that the United States had a maternal mortality rate of 23.8 deaths per 100,000 live births, nearly double the rate of New Zealand, the high-income country with the next highest rate of maternal mortality (13.6 per 100,000 live births) (Gunja et al., 2022). In 2022, the leading causes of maternal mortality in the United States were (1) mental health conditions including suicide and accidental overdose related to substance use disorder (SUD) (23%), (2) hemorrhage (14%), and (3) cardiac and coronary conditions (13%). The Centers for Disease Control and Prevention (CDC) estimated that more than 80% of these deaths were preventable (Centers for Disease Control and Prevention, 2022a). Kentucky's maternal mortality rate is the second highest in the nation (39.7 deaths per 100,000 live births), just behind Arkansas (40.4 deaths per 100,000 live births) (Hoyert, 2023). In 2018, SUD was determined to be a contributing factor in more than half of maternal deaths in Kentucky (Kentucky Department for Public Health, 2022).

In addition to maternal mortality, women in the United States experience high rates of maternal morbidity such as eclampsia, cardiac conditions, aneurysm, and hemorrhage (Fink et al., 2023). The CDC defines maternal morbidity as "outcomes related to labor and delivery that result in significant short- or long-term consequences to a woman's health" (Centers for Disease Control and Prevention, 2023c). A study of more than 11 million hospital discharges in the United States between 2008 and 2021 reported that rates of severe maternal morbidity have increased across all demographics but have been more pronounced among racial and ethnic minorities, patients who delivered via cesarean section, and among those with pre-existing comorbidities (Fink et al., 2023).

While the United States is experiencing a maternal health crisis, hospital obstetric units are closing their doors restricting, or even eliminating, access to maternity care for pregnant women. In 2023 alone, 23 hospitals closed their obstetric units (Kayser, 2023). These numbers continue to rise as 13 hospitals have already announced obstetric unit closures in 2024 (Ashley, 2024). Low birth volumes, financial challenges, and workforce shortages have been cited by hospitals as reasons for closing their obstetric units (Hung et al., 2016). These closures have implications for the availability of community-based maternity care providers. In 2023, nearly 5.6 million women in the United States lived in a maternity care desert, or a county with limited or no access to maternity care (March of Dimes, 2023b). States with higher rural populations, such as Kentucky, are disproportionately impacted by hospital obstetric unit closures and maternity care deserts (Kozhimannil et al., 2020). In 2023, 45.8% of counties in Kentucky were considered maternity care deserts, compared to 32.6% across the United States. Overall, 16.8% of all births in Kentucky are to women living in a maternity care desert. In addition to the lack of local maternity care providers, women living in maternity care deserts are disproportionately impacted by long travel distances to care compared to those not living in a maternity care desert. Women living in a maternity care desert in Kentucky must drive, on average, 35.6 miles to access care, compared to 16.9 miles among women living in a Kentucky county with full access to care (March of Dimes, 2023b).

1.1 Significance

While there has been broad media coverage and reporting on maternal mortality and, to some extent, maternal morbidity, less attention has been focused on prenatal care and its potential to improve birth outcomes. Prenatal care is one of the most frequently used healthcare services in the United States and has been associated with improved maternal and neonatal outcomes, including decreased risk of prematurity, and decreased risk of neonatal and infant death (Martin & Osterman, 2023; Partridge et al., 2012). The American College of Obstetricians and Gynecologists (ACOG) recommends that prenatal care begin in the first trimester and continue at a frequency determined by a woman's individual needs and risk assessment. The typical schedule of prenatal care visits for a woman with an uncomplicated pregnancy is a follow-up visit every four weeks in the first 28 weeks of gestation, every two weeks until 36 weeks of gestation, and every week until delivery, for a total of 12 to 14 in-person prenatal care visits (Peahl & Howell, 2021; The American College of Obstetricians and Gynecologists, 2017).

One known risk factor for maternal mortality and severe maternal morbidity is not receiving prenatal care (Howell, 2018). In its most recent report, the Kentucky Maternal Mortality Review Committee reported that, among the nine maternal deaths in the state in 2018, 21% had no prenatal care visits, 26% had one to four prenatal care visits, 25% had five to nine prenatal care visits, and 28% had more than ten visits (Kentucky Department for Public Health, 2022). Additionally, 58% of maternal deaths in Kentucky in 2018 were attributed to SUD, a condition that can be screened for, identified, and treated during pregnancy to prevent deaths (American Society of Addiction Medicine, 2017). While prenatal care alone cannot prevent maternal mortality and morbidity, it is one known contributor to optimal outcomes.

Prenatal care, initiated in the first trimester of pregnancy, henceforth referred to as "early prenatal care", provides an opportunity to establish the patient-provider relationship, identify potential risks to the pregnant person and fetus, create a comprehensive plan for care throughout pregnancy, and prepare for labor and delivery (The American College of Obstetricians and Gynecologists, 2017). Early prenatal care also provides a window of opportunity for screening and treatment of conditions such as sexually transmitted infections, SUD, psychosocial conditions, pre-existing chronic conditions such as hypertension or diabetes, and genetic anomalies (The American College of Obstetricians and Gynecologists, 2017). While the delivery and content of prenatal care varies between and within countries across the world, there is little debate that prenatal care should begin as early in pregnancy as possible (Cygan-Rehm & Karbownik, 2022). In 2021, the percentage of all women in the United States who received prenatal care in the first four months of pregnancy was 88.9%, with Black (84.1%) and Hispanic (85.2%) women less likely to receive early care (Martin & Osterman, 2023). In 2022, 21% of live births in Kentucky were to women who did not receive first-trimester prenatal care, a number that has remained unchanged since 2014. Notably, in some rural Kentucky counties, one-third of all births are to mothers who had no prenatal care (March of Dimes Peristats, 2022).

The reasons why women do not engage in early prenatal care, or attend care at all, are diverse and complex. Lack of access to transportation, inability to take time off work, having no or limited access to childcare, and long wait times for appointments are known barriers to delayed or no prenatal care (Camargo et al., 2023; Sebens & Williams, 2022). Structural and systemic barriers such as racism, mistrust of the healthcare system among those from historically marginalized communities, and a shrinking maternity care workforce also contribute to gaps and delays in the timing of prenatal care initiation (Centers for Medicare and Medicaid Services, 2019; Chambers et al., 2022). Barriers vary across sociodemographic characteristics such as immigration status, pregnancy intention, and socioeconomic status. In a recent study, Choi and colleagues found that anti-immigration rhetoric resulted in a 12% decrease in the odds of early prenatal care initiation among uninsured immigrants in the United States, compared to immigrants with private insurance (Choi et al., 2023). Women with SUD and those residing in a rural county have also been found to be at an increased risk of late entry to prenatal care (Baer et al., 2019).

The COVID-19 pandemic resulted in a myriad of systemic shifts that further exacerbated barriers and disparities in the timing of prenatal care initiation and the receipt of care. The CDC reported that, while the percentage of women with no or inadequate prenatal care was unchanged from 2019 to 2020, the percentage of women with intermediate care increased by 23% while the percentage of those receiving adequate or better care decreased by 9% (Martin & Osterman, 2023). There is mixed evidence about the impact of the COVID-19 pandemic on the timing of prenatal care initiation. One study of women in South Carolina found that, during the COVID-19 pandemic, both Black and White women had an increased odds of late prenatal care initiation, compared to pre-pandemic (Julceus et al., 2023). One study of a predominately Hispanic sample of women delivering in a Dallas, Texas hospital found that women presented earlier for prenatal care during the pandemic (mean gestational age of 11 weeks) compared to pre-pandemic (mean gestational age of 12 weeks) (Duryea et al., 2021). This study, however, was conducted in a hospital that rapidly implemented virtual audio-only prenatal care visits immediately following the start of the pandemic. Hospitals in rural areas of the country, for instance, may not have had the capacity to implement virtual prenatal care visits as quickly or at all, thereby negatively impacting the timing of prenatal care initiation in those communities. The differential results of these studies highlight the importance of understanding contextual and multi-level factors related to the timing of prenatal care initiation.

Early prenatal care is an important component of preventive care that merits further exploration in Kentucky, particularly because of high rates of maternal mortality and the disproportionate prevalence of maternity care deserts, compared to the rest of the United States. An understanding of both the depth and breadth of factors associated with the timing of prenatal care initiation in Kentucky can help identify who is, and who is not, receiving early or any prenatal care. A deeper understanding of barriers and facilitators for early entry to prenatal care can contribute to the development of targeted and community-based strategies to ensure that all women in Kentucky are able to initiate early prenatal care. Additionally, this information can support the implementation of data-driven policies that place Kentucky mothers and infants at the center.

1.2 Overview

To better understand factors associated with the timing of prenatal care initiation, this dissertation focuses on three specific aims:

- Aim 1: To identify factors associated with first-trimester prenatal care initiation in the United States.
- Aim 2: To identify and assess predictors of early prenatal care initiation among women in Kentucky.
- Aim 3: To assess the impact of the COVID-19 pandemic on the timing of prenatal care initiation among women in Kentucky.

Each of these specific aims is a focus of one of three dissertation chapters, all of which use a different methodology to examine factors associated with the timing of prenatal care initiation. While the methodologies vary based on the specific aim of the paper, the guiding framework for each, the Socioecological Model (SEM), is consistent throughout. The SEM provides a conceptual framework for this dissertation, one that acknowledges the interdependent relationships between individual, interpersonal and environmental factors, all of which impact access to and use of prenatal care (Stokols, 1996). Chapter 2 of this dissertation explores the breadth and depth of barriers and facilitators associated with first-trimester prenatal care initiation in the United States since the implementation of the Affordable Care Act (ACA), providing insight into gaps and opportunities in research and practice. Chapter 3 presents an assessment of multi-level factors associated with the timing of prenatal care initiation in Kentucky. Chapter 4, the final chapter of this dissertation, assesses the impact of the COVID-19 pandemic on the timing of prenatal care initiation in a sample of women in Kentucky.

The first paper, presented in Chapter 2, uses a scoping review methodology, following the Joanna Briggs Institute methodology for scoping reviews and the PRISMA-ScR extension, to systematically review recent research to identify factors associated with first-trimester prenatal care initiation (Page et al., 2021; Peters et al., 2020). All studies included in this review used a measure of prenatal care timing, allowing for a better understanding of the magnitude of impact of socioecological factors on first-trimester prenatal care initiation. This scoping review represents the first known synthesis of research regarding factors associated with first-trimester prenatal care among studies that use a measure of timing and among studies that use data following the implementation of the ACA. Given the changing landscape of maternity care in the United States in the last ten years, this scoping review is an important contribution to research that seeks to understand more about the existing landscape related to prenatal care initiation in the United States. While research about prenatal care continues to expand and evolve, this scoping review synthesizes and reflects on existing evidence regarding first-trimester prenatal care initiation and identifies gaps and future research directions. Additionally, the findings of the scoping review provide a foundation for the second paper of this dissertation by identifying important independent variables for inclusion in the analysis and informing the discussion and recommendation sections.

Chapter 3 contains the second dissertation paper, a closer look at factors associated with early prenatal care, defined as care initiated in the first twelve weeks of pregnancy, among women in Kentucky. Using data from Phase 8 (2017-2020) of the Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS), this paper presents the results of cross-sectional analyses designed to establish the relationship between several independent variables representing factors of prenatal care health insurance, maternal education, pregnancy intention, maternal age, maternal race, previous live births, household income, marital status, maternal residence, and WIC receipt, all of which have been associated with the timing of prenatal care initiation, the dependent variable. Chapter 3 uses a linear and logistic regression to more holistically understand factors related to early prenatal care initiation. The logistic regression stratifies findings by early or late initiation to compare characteristics of women in the sample by prenatal care timing. This chapter's focus on Kentucky is an important contribution to place-based policy and practice, given the state's growing shortage of maternity care providers, worsening pregnancy-related outcomes, and increasing maternal mortality. The findings of this paper provide a foundation for future analyses that can more deeply explore the association of early prenatal care with pre-conception insurance, pregnancy intention, and socioeconomic status.

The third and final paper (Chapter 4) in this dissertation uses a quasi-experimental methodology to assess the impact of the COVID-19 pandemic on the timing of prenatal care initiation among women in Kentucky. While the focus of Chapter 3 is primarily on factors in the individual, or intrapersonal, domain of the SEM, Chapter 4 expands the analysis to examine the impact of the COVID-19 pandemic as a factor in the SEM environmental domain. This analysis uses Phase 8 Kentucky PRAMS data, including the same independent variables used in Chapter 3 of this dissertation, to conduct a regression discontinuity to compare the timing of prenatal care initiation among women in Kentucky who conceived before and after the start of the COVID-19 pandemic. Using this methodology, Chapter 4 estimates the magnitude of effect that the start of the COVID-19 pandemic had on the timing of prenatal care initiation in Kentucky. This paper is a unique contribution to the existing body of knowledge as it represents the only known use of regression discontinuity to assess the impact of the COVID-19 pandemic on the timing of prenatal care initiation. This paper lays the groundwork for future research regarding the impact of the pandemic and other global disruptions to healthcare, not only on prenatal care timing but also on maternal and neonatal outcomes.

Together, these three papers provide a multi-layered view into the critical issue of the timing of prenatal care initiation. While the scoping review (Chapter 2) provides the perspective of a wider lens regarding the timing of prenatal care initiation, Chapters 3 and 4 provide a more contextual approach to understanding factors related to prenatal care timing. Collectively, these papers demonstrate the need for a more robust understanding of the prenatal care landscape in Kentucky, including the need to elevate the voices of women affected by lack of access to care. These studies provide the foundation for future research that narrows the scope and perspective even further, supporting a robust approach for understanding personal experiences as well as associated maternal and neonatal outcomes.

While hospitals and obstetric units around the country continue to close their doors, exacerbating maternity care shortages and widening disparities in access, women continue to require safe and acceptable places to receive prenatal care and give birth in their own communities. The findings of this dissertation can be used to build a robust research and practice agenda that ensures that all women in Kentucky have equitable access to prenatal care.

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CHAPTER TWO: FACTORS ASSOCIATED WITH FIRST-TRIMESTER PRENATAL CARE INITIATION IN THE UNITED STATES: A SCOPING REVIEW

2.0 Overview

OBJECTIVES: First-trimester prenatal care is initiated within the first twelve weeks of pregnancy and is associated with improved maternal and neonatal outcomes. Despite its importance, many pregnant women delay prenatal care initiation or receive no prenatal care. This scoping review assessed factors associated with first-trimester prenatal care initiation, using the Socioecological Model as a framework.

METHODS: A scoping review was conducted according to the Joanna Briggs Institute methodology for scoping reviews and followed the PRISMA-ScR guidelines for reporting. All papers were screened by two independent reviewers. Data were extracted using a customized data extraction template.

RESULTS: Of the 1,469 articles identified in the search, 19 met inclusion criteria and were included in the final review. Articles described cross-sectional (n=10), cohort (n=4), quasi-experimental (n=4), and mixed-methods (n=1) designs. A variety of socioecological factors were studied, including the impact of changes in access to care and care delivery during the COVID-19 pandemic (n=4), racial and ethnic disparities in initiation (n=4), the impact of social support programs (n=2), and Medicaid expansion or related policy changes (n=4). Inconsistencies were found in the measurement of first-trimester prenatal care initiation across studies.

CONCLUSIONS: Increasing the proportion of pregnant women who initiate first-trimester prenatal care will require comprehensive efforts that address sociodemographic and contextual factors, including persistent structural and systemic barriers that cause and widen health disparities.

KEYWORDS: Prenatal care, timing, access, scoping review

2.1 Introduction

The goal of prenatal care is to assess the health and well-being of the pregnant woman and fetus, provide prenatal education, complete recommended health screenings, and detect any conditions that may need to be monitored or addressed during the pregnancy or delivery to ensure optimal outcomes (The American College of Obstetricians and Gynecologists, 2017). First-trimester prenatal care initiation is associated with improved maternal and neonatal outcomes, including reductions in preterm birth and low birth weight (Thorsen et al., 2019; Thurston et al., 2021). Updated guidelines from The American College of Obstetricians and Gynecologists (2021) recommend that the first prenatal care visit take place between six and ten weeks of gestation, and continue at a frequency that meets the needs of the patient (Peahl et al., 2021). The first prenatal care visit is often the longest in duration and is intended to establish the patient-provider relationship, gather information about previous health history, plan a prenatal care visit schedule, perform necessary laboratory exams such as a confirmation pregnancy test, provide prenatal education and referrals if necessary, and discuss an overall plan of care (The American College of Obstetricians and Gynecologists, 2017).

Despite its importance, many pregnant women do not enter prenatal care in the first trimester as recommended. While the percentage of pregnant women who initiated first-trimester prenatal care in the United States slightly increased from 2019 (88.1%) to 2021 (88.9%), there remain significant disparities by sociodemographic and geographic factors. Among Black and Hispanic women, only 84.1% and 85.2%, respectively, initiated first-trimester prenatal care compared with 91.7% of White women. Similarly, 3.5% and 2.7% of Black and Hispanic women, respectively, received no prenatal care in 2021, compared with 1.4% of White women (Martin & Osterman, 2023).

There are a multitude of drivers of late or no entry into first-trimester prenatal care including: the use of public insurance, being unmarried, having lower maternal educational attainment, and having an unintended pregnancy (Baer et al., 2019; Dibaba et al., 2013). While many studies have focused on individual-level factors of first-trimester prenatal care initiation, there are fewer studies of structural and systemic factors or studies that include a measure of initiation in addition to contextualizing barriers and facilitators. The objective of this scoping review was to synthesize recent evidence regarding multi-level factors related to first-trimester prenatal care initiation in the United States in studies that included a defined measure of prenatal care timing. The research questions for this review were:

1) What socioecological factors are related to first-trimester prenatal care initiation in the United States?
2) What strategies and/or recommended future research directions have been suggested and/or implemented to improve first-trimester prenatal care initiation?
3) What measures of prenatal care timing have been used in the existing literature?

To answer these research questions, the Socioecological Model (SEM) was applied to categorize factors related to first-trimester prenatal care initiation that were identified in the literature, synthesize proposed solutions, and identify gaps in current research.

2.2 Methods

Given the exploratory and descriptive nature of the research questions, a scoping review was determined to be an appropriate methodology (Munn et al., 2018). The Joanna Briggs Institute (JBI) methodology for scoping reviews was followed as were reporting guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRIMSA-ScR, Appendix Table 1) (Peters et al., 2020; Tricco et al., 2018). A protocol was not registered for this review.

Search Strategy

A health sciences librarian (DL) designed and conducted the search strategy in collaboration with the study principal investigator (ME). Search strings were based on four key concepts: prenatal care, prenatal care utilization, time factors, and social determinants of health. The complete search strategy is outlined in Appendix Table 2. Electronic databases Cochrane, Embase, CINAHL, PubMed, and Social Sciences Abstracts were searched between October 27 and 31, 2023, and no date restrictions were placed on the searches. Reference lists of articles that were included in the final scoping review were hand-searched to identify relevant studies that may have been missed in the initial search.

Inclusion Criteria

All peer-reviewed articles that met the following inclusion criteria were included in the scoping review: 1) described studies that occurred in the United States, 2) focused on facilitators and barriers influencing first-trimester prenatal care initiation, 3) included a measure of prenatal care timing, 4) written in English, and 5) used data gathered after 2014 or focused on changes in first-trimester prenatal care before and after the implementation of the Affordable Care Act (ACA). This decision was made because coverage expansions that occurred under the ACA impacted access to preconception and prenatal insurance coverage (Bellerose, Collin, & Daw, 2022)

Study Selection

Covidence software was used to manage and organize the review process (Veritas Health Innovation, 2024). All articles retrieved through the initial search were uploaded into Covidence, and article titles and abstracts were screened by two independent reviewers (ME and BBI). Next, the full texts of articles that were identified as relevant were independently screened by both reviewers. Any disagreements were discussed and resolved by consensus. All papers included in the review were uploaded to an EndNote library for data extraction.

Data Extraction

A data extraction chart was created with categories including first author and year, purpose, population, setting/study period, study design/data source, primary outcome, and key findings. One reviewer (ME) extracted data from articles that met the inclusion criteria, and a second reviewer (BBI) checked and confirmed the data. A quality assessment of the papers included in this study was not conducted as this is not a requirement of a scoping review (Peters et al., 2020).

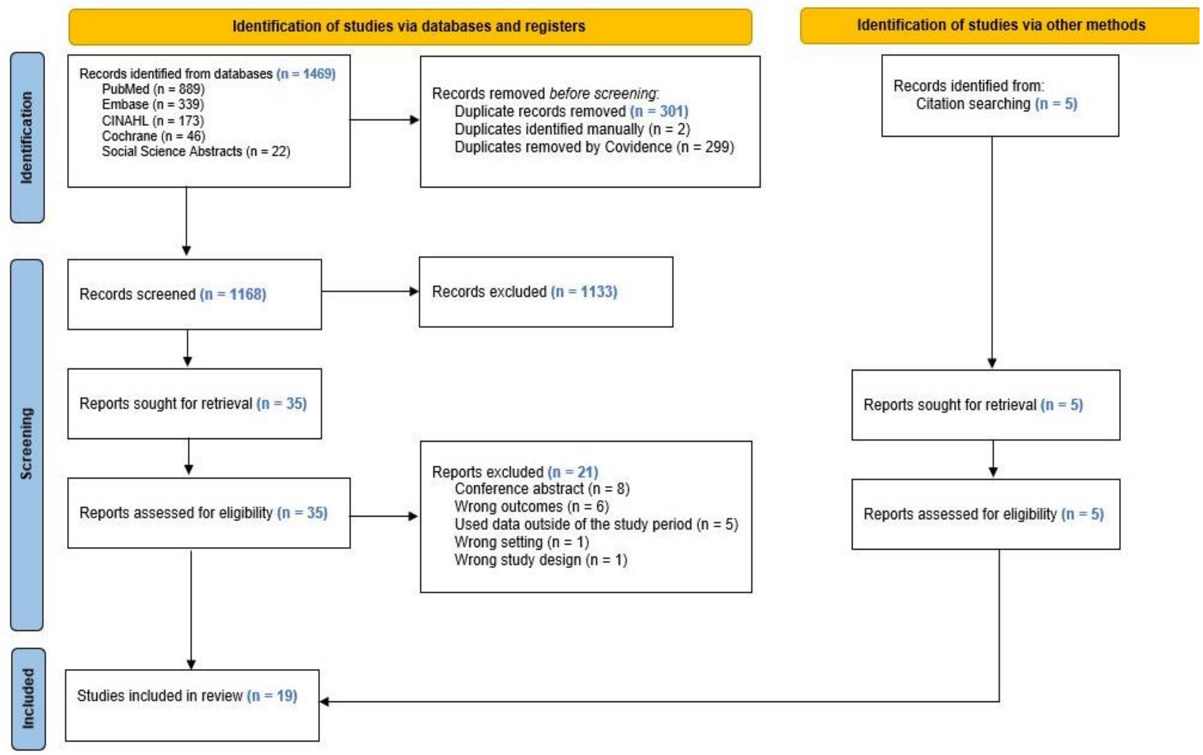
Data Synthesis

Recognizing that factors associated with first-trimester prenatal care initiation are influenced at multiple, interrelated levels, we used the SEM to synthesize findings (Stokols, 1996). The SEM provides a framework for more systematically understanding and relating factors in the intrapersonal, interpersonal, and environmental domains and supports the development of more holistic practice and policy recommendations.

2.3 Results

Figure 1 presents the study selection process in a PRISMA flow chart (Page et al., 2021). The initial search resulted in 1,469 results across all five databases. After duplicates were removed (n=302), 1,168 articles remained for the title/abstract review. We excluded 1,133 articles in the title/abstract review and conducted a full-text review of 35 articles. Twenty-one articles were excluded because: they did not use a defined measure of first-trimester prenatal care initiation (n=6), described studies performed outside the United States (n=1), were conference proceedings (n=8), used data outside of the study period (n=5), or were not an appropriate study design for inclusion in this review (n=1). Five additional articles were identified through hand-searching reference listings during the full-text review. The final review included 19 articles.

Figure 1. Study Selection Flow Chart



Study Characteristics

Research Context

Characteristics of included articles can be found in Table 1. All articles were published between 2019 and 2023, with the majority (n=13) published in 2022 and 2023 (Boguslawski et al., 2022; Camargo et al., 2023; Choi et al., 2023; Eliason & Daw, 2022; Janevic et al., 2022; Kennedy et al., 2022; Lanese et al., 2023; Lee & Singh, 2023; Peahl et al., 2022; Radke et al., 2023; Satcher et al., 2023; Schmidt et al., 2023; Sebens & Williams, 2022). Most articles described cross-sectional analyses (n=10) (Cruz-Bendezú et al., 2020; Harvey et al., 2021; Janevic et al., 2022; Julceus et al., 2023; Kennedy et al., 2022; Lee & Singh, 2023; Satcher et al., 2023; Schmidt et al., 2023; Sebens & Williams, 2022; Wang & Yang, 2019) though cohort studies (n=4) (Boguslawski et al., 2022; Duryea et al., 2021; Peahl et al., 2022; Radke et al., 2023), quasi-experimental (n=4)

(Choi et al., 2023; Eliason & Daw, 2022; Lanese et al., 2023; Li et al., 2019), and mixed methods designs (n=1) (Camargo et al., 2023) were also used. The most used (n=3) quasi-experimental method was difference-in-differences (Choi et al., 2023; Eliason & Daw, 2022; Li et al., 2019). One study employed a cross-sectional difference-in-differences and triple-difference analysis (Janevic et al., 2022).

The majority of studies (n=10) used birth records as their sole or primary data source (Choi et al., 2023; Eliason & Daw, 2022; Harvey et al., 2021; Janevic et al., 2022; Julceus et al., 2023; Lanese et al., 2023; Lee & Singh, 2023; Li et al., 2019; Radke et al., 2023; Wang & Yang, 2019). Harvey and colleagues (2021) used birth records linked with Medicaid claims and enrollment data, while two studies used Pregnancy Risk Assessment Monitoring System (PRAMS) data (Schmidt et al., 2023; Sebens & Williams, 2022). Five studies used data from electronic health records (Boguslawski et al., 2022; Cruz-Bendezú et al., 2020; Duryea et al., 2021; Peahl et al., 2022; Satcher et al., 2023), and three studies collected primary data through surveys and/or one-on-one interviews (Camargo et al., 2023; Cruz-Bendezú et al., 2020; Kennedy et al., 2022).

Population and Setting

Most articles described studies at the community- or state-level (n=15) (Boguslawski et al., 2022; Camargo et al., 2023; Cruz-Bendezú et al., 2020; Duryea et al., 2021; Eliason & Daw, 2022; Harvey et al., 2021; Julceus et al., 2023; Kennedy et al., 2022; Lanese et al., 2023; Peahl et al., 2022; Radke et al., 2023; Satcher et al., 2023; Schmidt et al., 2023; Sebens & Williams, 2022; Wang & Yang, 2019).

Four studies were conducted at the national level (Choi et al., 2023; Janevic et al., 2022; Lee & Singh, 2023; Li et al., 2019). Three studies were conducted in hospital settings in Atlanta, Michigan, and Dallas (Boguslawski et al., 2022; Duryea et al., 2021; Peahl et al., 2022). Two studies focused on rural communities in Iowa and Kansas (Kennedy et al., 2022; Radke et al., 2023)

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Table 1. Characteristics of Included Articles

First Author, Year	Purpose	Population	Setting/Study Period	Study Design/Data Source	Primary Outcome	Key Findings
Boguslawski, 2023	Describe the impact of a modified prenatal care model implemented during COVID-19	Pre-pandemic cohort (n=933) and pandemic-exposed cohort (n=747)	Public hospital in Atlanta, GA 2019-2020	Retrospective cohort Hospital electronic medical records	Indicator variable for initiation in first, second, or third trimester; first trimester defined as 0 weeks to 13 weeks and 6 days of pregnancy	A greater proportion of patients in the pandemic-exposed cohort initiated care in the first trimester than the pre-pandemic cohort and at an earlier gestational age.
Camargo, 2023	Identify barriers and facilitators associated with first-trimester prenatal care as perceived by Latina women, their supporters, and healthcare providers	Latina women over the age of 18 who had been pregnant in the previous five years (n=24), supporters (n=26), and providers (n=9)	Kansas City, MO July to September 2017	Mixed methods Focus groups, quantitative surveys, semi-structured interviews	First-trimester prenatal care; undefined	Barriers to care were unauthorized immigration status, fear of being deported, complexity of Medicaid paperwork, unsure of where to access care, cost, prenatal care literacy, low English proficiency, transportation, mental health distress.
Choi, 2023	Assess the impact of proposed changes to the Public Charge Rule on initiation of prenatal care among immigrants	Uninsured immigrants (treatme\nt group, n=433,658) and privately insured immigrants (comparison group, n=1,726,442)	47 states and D.C. January 1, 2014-December 31, 2019	Quasi-experimental; difference-in-differences Natality data from the National Center for Health Statistics	Trimester of initiation, defined by month of pregnancy; first trimester (months 1-3), second trimester (months 4-6), third trimester (months 7-final month), and no prenatal care.	A proposal of the Public Charge Rule was associated with a decrease in the odds of early prenatal care initiation in uninsured immigrants compared to privately insured immigrants.
Cruz-Bendezu, 2020	Examine relationship between pregnancy intent, maternal mental health, and prenatal care timing	Low-income women enrolled in First 1000 Days program (n=870) at community health centers	Greater Boston August 2016-September 2017	Cross-sectional Self-reported survey; electronic health records	First trimester initiation, defined as up to 13 weeks gestation	Women with an unintended pregnancy more likely to have late prenatal care and current stress and/or depression than those with intended pregnancy.
Duryea, 2021	Examine associations between audio-only virtual prenatal care visits during the COVID-19	Pre-pandemic cohort (n=6,559) Pandemic cohort (n=6,048)	Hospital in Dallas, TX 2019-2020	Cohort study Hospital electronic health records	Timing of prenatal care initiation measured by gestational age	Women presented earlier for prenatal care in 2020 compared to 2019.

First Author, Year	Purpose	Population	Setting/Study Period	Study Design/Data Source	Primary Outcome	Key Findings
	pandemic and perinatal outcomes					
Eliason, 2022	Assess the association between presumptive eligibility for pregnancy Medicaid and timely prenatal care	Live births among adults 20 years and older in KS (n=282,254) and a group of control states (n=2,693,333)	KS and a group of control states 2012-2019	Quasi-experimental; difference-in-differences National Center for Health Statistics Vital Statistics Birth Files	First trimester initiation, defined as months 0-3 of pregnancy	First-trimester prenatal care initiation increased by 1.92% among women with less than a high school education after presumptive eligibility in KS, relative to control states.
Harvey, 2021	Evaluate the impact of Oregon's Medicaid expansion on the timing and adequacy of prenatal care	Pre-expansion births (n=118,391), post-expansion births (n=99,938)	Oregon 2012-2016	Cross-sectional Birth certificates linked with Medicaid claims and enrollment files	Timely initiation of prenatal care, defined as up to 13 weeks of pregnancy	Receipt of first-trimester prenatal care increased post-Medicaid expansion. Among Hispanic women, first-trimester care increased by 2.4% post-expansion.
Janevic, 2022	Assess changes in prenatal care timing by nativity after Medicaid expansion	Singleton live births in 31 states (n=22,042,624); 16 expansion states and 15 non-expansion states	United States January 1, 2011-December 31, 2019	Cross-sectional difference-in-differences United States Natality Data	Indicator variable for first-trimester prenatal care initiation; first trimester undefined	In Medicaid expansion states, timely prenatal care improved among U.S.-born women but not Asian and Hispanic immigrant women. There were larger disparities among women with less education.
Julceus, 2021	Assess prenatal care utilization pre- and post-COVID-19 pandemic and whether race was a moderating factor	All pregnant women who gave birth in the study period	South Carolina January 2018-June 2021	Cross-sectional Birth certificates	Initiation of prenatal care in the first three months gestation	During the pandemic period, fewer women received prenatal care than pre-pandemic. Black women more likely to have not initiated any care by the third trimester compared to White women during the pandemic.
Kennedy, 2022	Identify differences in prenatal care utilization based on distance	Women at least 18 years old who were pregnant or had been pregnant in the last three years	Kansas June 22, 2020-July 17, 2020	Cross-sectional Quantitative survey; retrospective recall	First, second, or third trimester initiation; trimesters undefined	No statistically significant difference in first-trimester care by cohort.

First Author, Year	Purpose	Population	Setting/Study Period	Study Design/Data Source	Primary Outcome	Key Findings
	traveled to prenatal care	and delivered in a rural county (n=77); assessed based on distance traveled to prenatal care (<19 miles or ≥20 miles)				
Lanese, 2023	Assess the impact of a care coordination model (THRIVE) on racial disparities in prenatal care adequacy	Intervention group (THRIVE participants, n=112), comparison group (non-THRIVE participants, n=112)	Stark County, Ohio 2017-2020	Quasi-experimental; propensity score matching Birth certificates, de-identified client data from THRIVE records	First-trimester initiation, defined as before the end of the fourth month of pregnancy	A higher percentage of THRIVE participants, compared to non-participants, initiated prenatal care prior to the end of the fourth month of pregnancy.
Lee, 2023	Estimate the association of COVID-19 and prenatal care utilization by race and ethnicity and Medicaid expansion status	Expansion states (n=4,756,979) and non-expansion states (n=2,258,382)	United States 2019-2020	Cross-sectional National Natality files	Two dichotomous variables indicating 1) receipt of any prenatal care (yes/no) and 2) no prenatal care or delayed care, defined as seeking care in the seventh to final month of pregnancy (third trimester) or seeking care in the first six months of pregnancy	Women in non-expansion states more likely to receive delayed or no prenatal care compared to women in expansion states during the pandemic. In non-expansion states, AI/AN and Asian and Pacific Islanders were more likely to have no or delayed prenatal care compared to non-Hispanic Whites.
Li, 2019	Examine the impact of the Medicaid Primary Care Rate Increase ("fee bump") on prenatal care utilization among women with Medicaid	Medicaid-covered births conceived during the study period in states with a smaller fee bump (control group, 18 states, n=1,249,138) and a larger fee bump (treatment group, 19 states, n=4,965,480)	37 states April 2009-March 2014	Quasi-experimental; difference-in-differences Birth Data of the National Vital Statistics System and Area Health Resources File	First-trimester prenatal care initiation, defined as months 0-4 of pregnancy	Non-Hispanic Black women in large fee bump states had higher odds of initiating prenatal care in the first trimester after the fee bump was implemented compared to their counterparts in states with small fee bumps. There was no effect of the fee bump on prenatal care timing among Hispanic women.

First Author, Year	Purpose	Population	Setting/Study Period	Study Design/Data Source	Primary Outcome	Key Findings
Peahl, 2022	Describe the distribution of risk factors, prenatal care utilization, and health outcomes by patient-specific medical and psychosocial needs	All patients who received outpatient prenatal care and gave birth at the institution during the study period; four groups based on patient phenotypes N=4,681	Academic hospital in Michigan January 1 to December 31, 2018	Retrospective cohort study Electronic health records	Gestational week at first visit; length of trimester not defined	Patients with psychosocial risk factors initiated prenatal care later than those without psychosocial risk factors. Black and Hispanic patients had higher psychosocial risk factors than White patients.
Radke, 2023	Examine the effects of labor and delivery unit closures on the adequacy of prenatal care for pregnant people in those communities	Iowa residents who gave birth in rural counties with open labor and delivery units in 2017 (47 counties, n=29,556 births)	Iowa counties with open labor and delivery units in 2017 January 1, 2017-January 1, 2019	Retrospective cohort study Birth certificates	First-trimester initiation; length of trimester not defined	No difference in the timing of initiation compared to counterparts in counties with non-closures. Timeliness of care among women with Medicaid was made worse with L&D unit closures.
Satcher, 2023	Identify biomedical, psychosocial, and social correlates of adequate prenatal care among pregnant women experiencing criminal-legal involvement and opioid use disorder (CL-OUD)	n=1,795 Sub-analysis sample (n=317)	A rural region of Northeastern New England 2015-2020	Cross-sectional Sub-analysis of medical records data collected as part of a comparative effectiveness study	Early prenatal care initiation, defined as less than 14 weeks gestation	Women with two or three prior pregnancies, buprenorphine at prenatal care initiation, stable housing, and experience in court diversion or community supervision were more likely to initiate early prenatal care than their counterparts.
Schmidt, 2023	Explore interpersonal violence in the context of ACEs as a contributor to racial disparities in prenatal care	Women in North Dakota (n=1,849)	North Dakota 2017-2019	Cross-sectional North Dakota PRAMS	Early prenatal care initiation, defined as initiated by week 12 of pregnancy	No association between racial disparities in prenatal care timing and pre-pregnancy interpersonal violence. AI women with high and low ACEs had higher odds of late initiation compared to White women with low ACEs.

First Author, Year	Purpose	Population	Setting/Study Period	Study Design/Data Source	Primary Outcome	Key Findings
	access and satisfaction					
Sebens, 2022	Examine structural and sociocultural determinants of prenatal care access among AI and White women	Women in North Dakota (n=1,415)	North Dakota 2017-2018	Cross-sectional North Dakota PRAMS	Late prenatal care initiation, defined as greater than 13 weeks gestation	AI/AN women were more likely to present late for prenatal care, compared to White women, and more likely to report a higher prevalence of socioeconomic barriers.
Wang, 2019	Assess the impact of long commutes to work on fetal and infant outcomes and prenatal care utilization	New Jersey residents with a singleton live birth and were employed by a New Jersey, New York, or Pennsylvania-based employer in the year prior to pregnancy (n=826)	New Jersey 2014-2015	Cross-sectional New Jersey Birth Records	First trimester prenatal care initiation, defined as date of last menstrual period to 13 and 6/7 weeks of pregnancy	An increase of 10 miles in maternal travel distance during pregnancy decreased the probability of timely prenatal care.

Socioecological Factors Influencing First-Trimester Prenatal Care Initiation

The articles included in this scoping review assessed first-trimester prenatal care initiation across all domains of the SEM, including intrapersonal, interpersonal, and environmental.

Intrapersonal factors such as race and ethnicity, nativity, immigration status, and pregnancy intention were explored in the majority of articles. Three articles focused primarily on immigrant populations (Camargo et al., 2023; Choi et al., 2023; Janevic et al., 2022). Four articles examined the relationship of psychosocial factors and first-trimester prenatal care initiation (Camargo et al., 2023; Cruz-Bendezú et al., 2020; Peahl et al., 2022; Satcher et al., 2023). Two articles focused on adverse childhood experiences (ACEs) and interpersonal violence (Schmidt et al., 2023) among American Indian (AI) women and opioid use disorder among women with a history of criminal-legal involvement (Satcher et al., 2023). Though most articles examined racial disparities, six papers centered racial disparities in the aims of their study (Janevic et al., 2022; Julceus et al., 2023; Lanese et al., 2023; Lee & Singh, 2023; Schmidt et al., 2023; Sebens & Williams, 2022).

Interpersonal factors were the least explored domain of the SEM (n=2) (Camargo et al., 2023; Schmidt et al., 2023). The most commonly studied environmental factors were the COVID-19 pandemic (n=4) (Boguslawski et al., 2022; Duryea et al., 2021; Julceus et al., 2023; Lee & Singh, 2023) and the impact of policies such as Medicaid (n=5) (Choi et al., 2023; Eliason & Daw, 2022; Harvey et al., 2021; Janevic et al., 2022; Li et al., 2019).

Summary of Factors Related to First-Trimester Prenatal Care Initiation

The SEM acknowledges that individual behavior, perceptions, and outcomes, or intrapersonal factors, are shaped by interpersonal and environmental factors (Stokols, 1996). Interpersonal factors include an individual's networks and relationships with peers, family members, friends, and healthcare providers. The environmental domain refers to the built environment, community-level factors, policies, and structural and systemic factors (Stokols, 1996). Using the SEM to synthesize existing evidence about first-trimester prenatal care initiation can support the identification of gaps in research and practice that can contribute to a more holistic approach to improving outcomes for pregnant women and infants. Table 2 summarizes barriers and facilitators to first-trimester prenatal care initiation within each domain of the SEM.

Intrapersonal

At the intrapersonal level, barriers to first-trimester prenatal care initiation included the presence of psychosocial factors, lack of childcare, lack of engagement with the healthcare system prior to pregnancy, unintended pregnancy, lack of access to transportation, fear of deportation, difficulties completing Medicaid enrollment paperwork, no health insurance coverage, and lack of healthcare and prenatal care literacy (Camargo et al., 2023; Choi et al., 2023; Cruz-Bendezú et al., 2020; Lanese et al., 2023; Peahl et al., 2022; Satcher et al., 2023; Sebens & Williams, 2022). Facilitators were prior pregnancies, the opportunity for pregnancy prevention education at the prenatal care visit, pre-pregnancy Medicaid enrollment, higher educational attainment, WIC receipt, stable housing, buprenorphine use at prenatal care initiation, and experience in court diversion (Camargo et al., 2023; Harvey et al., 2021; Lanese et al., 2023; Satcher et al., 2023).

The relationship between psychosocial factors and first-trimester prenatal care initiation was the most studied intrapersonal factor (n=4). One article described the association of mental health distress about the fear of deportation as a psychosocial factor influencing first-trimester care initiation in a sample of Latina immigrants. Similarly, having an unauthorized immigration status was negatively associated with prenatal care utilization (Camargo et al., 2023). Satcher and colleagues studied a sample of women with opioid use disorder, high prevalence of psychiatric disorders, and medical morbidities and found that those who used buprenorphine at prenatal care initiation, had stable housing, and had previous experience in court diversion or community supervision were more likely to initiate first-trimester prenatal care compared to their counterparts (Satcher et al., 2023). Cruz-Bendezu and colleagues assessed the intersection of maternal mental health and unintended pregnancy among women enrolled in a social support program at community health centers in the Boston area. The research team found a negative association between first-trimester prenatal care initiation and unintended pregnancy, with 24.7% of women with an unintended pregnancy initiating care after the first trimester (Cruz-Bendezú et al., 2020). Peahl and colleagues assessed variation in prenatal care utilization by psychosocial factors and found that women with psychosocial factors initiated care three weeks later than those without psychosocial factors. They also reported that Black and Hispanic patients had a higher prevalence of psychosocial factors compared to White patients (Peahl et al., 2022).

A lack of engagement with the healthcare system prior to pregnancy, including pre-pregnancy health insurance coverage and healthcare literacy, was cited as a barrier to first-trimester prenatal care in two studies, one of immigrants and another of low-income women (Camargo et al., 2023; Cruz-Bendezú et al., 2020). Cruz-Bendezu and colleagues found that, in their sample of low-income women, 30.8% had not visited a primary care provider in the year prior to initiating prenatal care (Cruz-Bendezú et al., 2020). Similarly, Camargo and colleagues identified a lack of health insurance coverage and low healthcare and prenatal care literacy as barriers to first-trimester prenatal care initiation among Latina immigrants. In the same study, difficulties completing complex Medicaid paperwork to enroll in insurance during pregnancy was cited as an additional barrier. The research team also identified a high prevalence of gestational diabetes in the study sample, which resulted in a higher cost of care, a barrier to initiation for immigrants who were uninsured (Camargo et al., 2023).

Lack of childcare, language proficiency, transportation to prenatal care appointments, and a lack of healthcare and prenatal care literacy were found to be barriers in three studies, two in studies of immigrant populations (Camargo et al., 2023; Choi et al., 2023) and another among American Indian women (Sebens & Williams, 2022). Schmidt and colleagues assessed interpersonal violence in the context of adverse childhood experiences (ACEs) as a contributor to racial disparities in prenatal care access among American Indian women in North Dakota. They found that exposure to interpersonal violence did not have an effect on racial disparities in access to care but that American Indian women with higher ACEs were two times more likely to initiate late prenatal care compared with White women with fewer ACEs (Schmidt et al., 2023).

One facilitator of first-trimester prenatal care was having a prior pregnancy. Satcher and colleagues found that women with opioid use disorder who had gravidity of two or three were 2.71 times more likely to have timely prenatal care than women who were experiencing their first pregnancy (Satcher et al., 2023). Other facilitators among those with opioid use disorder and criminal-legal system involvement included buprenorphine at first prenatal care visit, experience with court diversion programs relative to incarceration, and having stable housing (Satcher et al., 2023). The opportunity to learn more about pregnancy prevention at prenatal care was a motivator for prenatal care utilization in a Latina population (Camargo et al., 2023). Related to healthcare system engagement, pre-pregnancy Medicaid enrollment was positively associated with first-trimester prenatal care (Harvey et al., 2021).

Interpersonal

The interpersonal domain was the least explored across articles, with only two papers focusing on this domain (Camargo et al., 2023; Schmidt et al., 2023). Camargo and colleagues assessed interpersonal barriers and facilitators of first-trimester prenatal care initiation among Latina women, their supporters, and their healthcare providers. Facilitators for first-trimester initiation were social support from friends and family and the availability of Spanish-proficient translators who could accurately provide information during the patient-provider interaction. They reported that inadequate Spanish translation services often resulted in misunderstanding and mistrust in the patient-provider relationship, which contributed to low prenatal care utilization (Camargo et al., 2023).

Environmental

Twelve articles described environmental-level factors impacting first-trimester prenatal care initiation, including: Medicaid-related factors (n=4) (Eliason & Daw, 2022; Harvey et al., 2021; Janevic et al., 2022; Li et al., 2019), the COVID-19 pandemic (n=4) (Boguslawski et al., 2022; Duryea et al., 2021; Julceus et al., 2023; Lee & Singh, 2023), the impact of immigration-related policy (n=1) (Choi et al., 2023), factors related to the rural context (n=2) (Kennedy et al., 2022; Radke et al., 2023), and maternal commuting time to work (n=1) (Wang & Yang, 2019).

Four articles examined the effect of Medicaid on first-trimester prenatal care (Eliason & Daw, 2022; Harvey et al., 2021; Janevic et al., 2022; Li et al., 2019). Harvey and colleagues found that after Medicaid expansion was implemented in Oregon, first-trimester prenatal care increased by 1.5% among all women and 2.4% among Hispanic women. Following expansion, women were more likely to be enrolled in Medicaid the month prior to pregnancy, which was positively associated with first-trimester initiation. Among Hispanic women, the probability of pre-pregnancy Medicaid enrollment increased by 16%, but there was no significant association between pre-pregnancy Medicaid enrollment and prenatal care adequacy for Hispanic women, indicating barriers to care outside of insurance status (Harvey et al., 2021). Comparing Medicaid expansion and non-expansion states, Janevic and colleagues found post-expansion increases in timely prenatal care among U.S.-born women but not Asian or Hispanic immigrants and larger disparities in timely initiation among women with less education. Decreases in timely prenatal care were observed among Black immigrant women in non-expansion states. The authors concluded that Medicaid exclusions for immigrants serve as a form of structural racism that results in poorer outcomes (Janevic et al., 2022).

Eliason and Daw assessed the impact of Medicaid presumptive eligibility for pregnant women in Kansas and found that first-trimester prenatal care increased by 1.92% among women with less than a high school education following implementation. After presumptive eligibility, disparities in first-trimester care persisted, with 23% of parents with less than a high school education still not initiating first-trimester care (Eliason & Daw, 2022).

Li and colleagues examined the association of the Medicaid Primary Care Fee Bump, comparing states with small versus large fee bumps, and found that non-Hispanic Black women in large fee bump states had 9% higher odds of first-trimester prenatal care after the fee bump was implemented compared to their counterparts in states with small fee bumps. In non-Medicaid expansion states, non-Hispanic Black women in large fee bump states had 13% higher odds of first-trimester prenatal care initiation. There was a small but significant increase in prenatal care utilization among non-Hispanic Black women following the Primary Care Fee Bump, suggesting a narrowing of racial disparities. The fee bump had no effect on the timing of initiation among Hispanic women (Li et al., 2019).

The impact of the COVID-19 pandemic on first-trimester prenatal care initiation was examined in four studies (Boguslawski et al., 2022; Duryea et al., 2021; Julceus et al., 2023; Lee & Singh, 2023). Two studies, both hospital-based, found that the implementation of telehealth prenatal care visits during the pandemic increased the likelihood of first-trimester initiation at earlier gestational ages (Boguslawski et al., 2022;

Duryea et al., 2021). Boguslawski and colleagues reported low uptake of telehealth for prenatal care during the COVID-19 pandemic in their study sample, resulting in an overall decrease in the number of women receiving prenatal care, with a larger decrease observed among Hispanic women. While fewer women initiated prenatal care, they found that a greater proportion of pregnant women initiated first-trimester prenatal care during the COVID-19 pandemic than prior to the pandemic (Boguslawski et al., 2022). Duryea and colleagues compared prenatal care timing among women who delivered prior to the COVID-19 pandemic and attended prenatal care visits in-person to those who delivered during the pandemic and used integrated audio-only virtual prenatal care visits. They found that women in the pandemic cohort initiated prenatal care, on average, one week earlier than those in the pre-pandemic cohort, suggesting that audio-only virtual prenatal care visits may improve first-trimester initiation (Duryea et al., 2021). In a study of women in South Carolina, Julceus and colleagues found that, during the pandemic, 3.7% of women did not receive any prenatal care, compared to 1.5% of women in the pre-pandemic period. During the pandemic period, Black women were more likely to have not initiated any care by the third trimester (30.0%) compared to White women (23.1%), widening racial disparities in prenatal care receipt (Julceus et al., 2023).

Lee and Singh (2023) examined the intersection of COVID-19 and Medicaid expansion by race and ethnicity and found that women in non-Medicaid expansion states were 50% more likely to receive delayed or no prenatal care compared to women in expansion states. Additionally, the research team found that American Indian or Alaska Native (AI/AN) and Asian and Pacific Islander women were more likely to have no or delayed prenatal care compared to non-Hispanic White women during the COVID-19 pandemic. The authors hypothesized that women in expansion states experienced decreases in no or delayed prenatal care during the pandemic because of an increase in telehealth visits during the pandemic. Additionally, they hypothesized that decreased insurance churn in expansion states during the pandemic contributed to more timely prenatal care, compared to non-expansion states (Lee & Singh, 2023).

One article studied the impact of the Public Charge Rule on prenatal care timing among immigrants in the United States (Choi et al., 2023). The Public Charge Rule, a provision of United States immigration law that allowed agencies to deny applications from immigrants seeking to enter the country or become permanent residents based on the likelihood that they would become dependent on government benefits, was in effect from February 2020 to March 2021. Choi and colleagues found that the Public Charge Rule was associated with a 12% decrease in the odds of first-trimester prenatal care initiation in uninsured compared to privately insured immigrants.

Sebens and Williams (2022) used North Dakota PRAMS data to assess structural and socioeconomic determinants of prenatal care timing among White and American Indian/Alaska Native women in North Dakota. They found that American Indian/Alaska Native women were 1.93 times more likely to have late prenatal care, compared to White women, and more likely to report a higher prevalence of socioeconomic barriers such as lack of transportation and no access to childcare. They also reported that 14 times more American Indian/Alaska Native women than White women reported delayed prenatal care because they wanted to keep their pregnancy a secret.

Cruz-Bendezú and colleagues (2020) assessed prenatal care timing among 870 low-income women enrolled in the First 1,000 Days Program and found that women with an unintended pregnancy were more likely to have late prenatal care than those with an intended pregnancy. Lanese and colleagues (2023) evaluated prenatal care timing in the context of a care coordination model and found that a higher percentage of THRIVE program participants (66.1%), compared to non-participants (31.3%), initiated prenatal care prior to the end of the first trimester of pregnancy. Additionally, THRIVE participants had more overall prenatal care visits during pregnancy than non-THRIVE participants.

Two articles focused on first-trimester prenatal care in the context of rural communities (Kennedy et al., 2022; Radke et al., 2023). In a study of women who gave birth in rural Kansas, Kennedy and colleagues (2022) found no association between prenatal care timing and distance traveled for care, but did find an association between fewer numbers of visits in the third trimester and prenatal care adequacy, concluding that rural residence may be less associated with delayed care than driving distance to prenatal care. Radke and colleagues (2023) studied women living in rural Iowa counties where labor and delivery units had closed compared to women residing in rural counties with a currently operating labor and delivery unit. In communities with a closed labor and delivery unit, women were less likely to have an overall adequate number of prenatal care visits but not less likely to initiate early care. Medicaid recipients in counties with labor and delivery unit closures had a significantly higher likelihood of not initiating early care and not receiving an adequate number of prenatal care visits, compared to their counterparts in counties without closures. Wang and Yang (2019) assessed the impact of maternal commuting distance to work on prenatal care timing, hypothesizing that long commutes to work present an opportunity cost that may result in delaying the initiation of prenatal care. The team found that an increase of ten miles in maternal commuting distance during pregnancy decreased the probability of initiating first-trimester prenatal care by 2.4%.

Table 2. Barriers and Facilitators to First-Trimester Prenatal Care by SEM Domain

SEM Domain	Barriers	Citation(s)	Facilitators	Citation(s)
Intrapersonal	Psychosocial factors	Camargo et al. (2023); Cruz-Bendezú et al. (2020); Peahl et al. (2022); Satcher et al. (2023)	Prior pregnancies	Camargo et al. (2023); Satcher et al. (2023)
	Lack of childcare	Camargo et al. (2023); Sebens and Williams (2022)	Pregnancy prevention education at prenatal care visit	Camargo et al. (2023)
	Language proficiency	Camargo et al. (2023)		
	Lack of engagement with healthcare system prior to pregnancy	Cruz-Bendezú et al. (2020)	Pre-pregnancy Medicaid enrollment	Harvey et al. (2021)
	Lack of transportation	Camargo et al. (2023); Sebens and Williams (2022)	Higher educational attainment	Lanese et al. (2023)
	Fear of deportation	Camargo et al. (2023)	WIC receipt	Lanese et al. (2023)
	Difficulties completing complex Medicaid enrollment paperwork	Camargo et al. (2023)	Stable housing	Satcher et al. (2023)
	No health insurance; cost of out-of-pocket care	Camargo et al. (2023); Choi et al. (2023); Sebens and Williams (2022)	Buprenorphine use at prenatal care initiation	Satcher et al. (2023)
	Lack of healthcare literacy	Camargo et al. (2023); Choi et al. (2023)	Experience in court diversion (vs. incarceration)	Satcher et al. (2023)
	Presence of childhood ACEs	Schmidt et al. (2023)	Participation in THRIVE program	Lanese et al. (2023)
Interpersonal	Misunderstanding and mistrust between patient and provider	Camargo et al. (2023)	Social support; peer navigation	Camargo et al. (2023)

SEM Domain	Barriers	Citation(s)	Facilitators	Citation(s)
Environmental	Language barriers/inadequate interpretation services	Camargo et al. (2023)	Effective patient-provider communication	Camargo et al. (2023)
	Impact of COVID-19 pandemic	Boguslawski et al. (2022); Duryea et al. (2021); Julceus et al. (2023); Lee and Singh (2023)	Multi-modes of care delivery (e.g. audio-only, telehealth)	Boguslawski et al. (2022); Duryea et al. (2021)
	Public Charge Rule/anti-immigration rhetoric	Choi et al. (2023)	Presumptive eligibility; increased awareness	Eliason and Daw (2022)
	Distance traveled to prenatal care	Kennedy et al. (2022)	Medicaid expansion	Lee and Singh (2023)
	Medicaid exclusions for immigrants; structural racism	Janevic et al. (2022)	Long commutes to work	Wang and Yang (2019)
	Labor and delivery unit closures in rural communities	Radke et al. (2023)		

Research and Practice Recommendation from Included Articles

Selected research and practice recommendations were extracted from articles and reported in Table 3 by SEM domain. In the intrapersonal domain, expanding access to education and services for pregnant women was the most frequently occurring recommendation (n=5) (Camargo et al., 2023; Harvey et al., 2021; Julceus et al., 2023; Peahl et al., 2022; Satcher et al., 2023). Fewer articles presented recommendations related to the interpersonal domain (n=3) (Camargo et al., 2023; Julceus et al., 2023; Peahl et al., 2022). The highest concentration of recommendations was in the environmental domain, where many of the articles focused their research designs. Twelve articles recommended policies or practices to improve first-trimester prenatal care at the environmental level (Boguslawski et al., 2022; Camargo et al., 2023; Eliason & Daw, 2022; Harvey et al., 2021; Janevic et al., 2022; Lanese et al., 2023; Li et al., 2019; Peahl et al., 2022; Satcher et al., 2023; Schmidt et al., 2023; Sebens & Williams, 2022; Wang & Yang, 2019).

Table 3.Selected Research and Practice Recommendations by SEM Domain

Intrapersonal	
Use technology and social media to increase utilization of prenatal care.	Camargo et al. (2023)
Expand access to education and services for pregnant women, including addressing psychological needs (e.g. MOUD).	Camargo et al. (2023); Harvey et al. (2021); Julceus et al. (2023); Peahl et al. (2021); Satcher et al. (2023)
Implement and evaluate social service programs, (e.g. prenatal care coordination); assess impact on outcomes.	Lanese et al. (2023); Li et al. (2019)
Consider underlying determinants of racial and ethnic disparities in program and practice implementation.	Lee and Singh (2023)
Interpersonal	
Train providers on the role of culture in communication and on techniques for patient engagement.	Camargo et al. (2023)
Increase access to language-proficient healthcare providers and materials in multiple languages.	
Implement patient-centered care approaches.	Julceus et al. (2023)
Implement strategies for re-imagined contact with healthcare providers (e.g. text messaging).	Peahl et al. (2022)
Environmental	
Additional support for staff and patients at safety net hospitals to fully integrate and accept telehealth.	Boguslawski et al. (2022)
Expand access to maternal healthcare; expand workforce and modes of care delivery.	Li et al. (2019); Radke et al. (2023); Satcher et al. (2023); Sebens and Williams (2022)
Expand healthcare coverage regardless of pregnancy; assess long-term effects of Medicaid expansion on prenatal care utilization.	Camargo et al. (2023); Harvey et al. (2021); Sebens and Williams (2022)
Equitable reimbursement for audio-only telehealth.	Duryea et al. (2021)
Assess effects of presumptive eligibility for Medicaid on diverse populations and effects on outcomes.	Eliason and Daw (2022)
Increase public awareness of availability of presumptive eligibility.	
Monitor HP 2030 goals by race, ethnicity, and nativity to increase attention to disparities.	Janevic et al. (2022)
Invest in comprehensive programming and policy (e.g., WIC).	Lanese et al. (2023)
Assess magnitude of changes in telehealth visits in Medicaid expansion vs. non-expansion states during COVID-19.	Lee (2023)
Higher Medicaid reimbursements to improve access to care.	Li et al. (2019)

Focus on digital equity in telehealth.	Peahl et al. (2021)
Assess the appropriateness of the Kotelchuck index as a measure of adequacy of prenatal care for high-risk populations. Assess the impact of community-based alternatives to incarceration on birth outcomes and prenatal care utilization. Establish professional guidelines and processes for full assessment and documentation of SUD and biopsychosocial contexts.	Satcher et al. (2023)
Additional research with unmeasured confounders related to systemic and structural oppression.	Schmidt et al. (2023)
Implement alternative methods of care delivery (e.g. telehealth, mobile clinics). More funding and evaluation to determine the effectiveness of alternative methods of care delivery.	Sebens and Williams (2022)
Enact prenatal maternity leave policies to encourage attending prenatal care visits.	Wang and Yang (2019)

Measures of Prenatal Care Timing

Central to the aims of this scoping review, all included studies used a measure of prenatal care timing. Prenatal care timing was defined differently across studies. Among studies assessing first-trimester prenatal care, three articles defined the first trimester as up to 14 weeks gestation (Boguslawski et al., 2022; Satcher et al., 2023; Wang & Yang, 2019), two articles defined the first trimester as up to 13 weeks gestation (Cruz-Bendezú et al., 2020; Harvey et al., 2021), and four articles defined the first trimester as the first three months of pregnancy (Choi et al., 2023; Eliason & Daw, 2022; Julceus et al., 2023; Schmidt et al., 2023). Sebens and colleagues assessed late prenatal care, defined as care initiated after week 13 of pregnancy (Sebens & Williams, 2022). Two articles assessed prenatal care initiation by the end of the fourth month of pregnancy, aligned with the timing component of the Adequacy of Prenatal Care Utilization Index (Lanese et al., 2023; Li et al., 2019). Duryea and colleagues assessed timing of prenatal care, using gestational age as a continuous variable (Duryea et al., 2021). Lee and Singh used dichotomous variables to indicate whether women receive any prenatal care and categorized timing as seeking care in the third trimester (month 7 to final month of pregnancy) or seeking care in the first six months of pregnancy (Lee & Singh, 2023). Five studies did not define the range of weeks included in the first trimester (Camargo et al., 2023; Janevic et al., 2022; Kennedy et al., 2022; Peahl et al., 2022; Radke et al., 2023).

2.4 Discussion

The purpose of this scoping review was to identify socioecological factors associated with first-trimester prenatal care initiation in the United States among articles that used a measure of prenatal care timing. Using the Socioecological Model, barriers and facilitators were identified in the intrapersonal, interpersonal, and environmental domains (Stokols, 1996). Research, policy, and practice recommendations were concentrated at the environmental level with the two most commonly cited recommendations focused on expanding access to maternal healthcare, including expanding the maternity care workforce and modes of care delivery, and providing access to insurance coverage regardless of pregnancy. Related to aim 3, we found inconsistencies in the measurement of first-trimester prenatal care initiation across studies.

Overall, most articles evaluated socioecological factors in the intrapersonal and environmental domains with fewer studies evaluating factors in the interpersonal domain. All articles, except for one, used a quantitative approach, making the identification of contextual barriers and facilitators challenging. Camargo and colleagues, using a mixed-methods design, identified several barriers and facilitators to first-trimester care in a sample of mostly Latina immigrants (Camargo et al., 2023). This study is a valuable contribution to the literature, particularly in light of findings from several studies of persistent disparities in first-trimester prenatal care initiation in immigrant populations. Barriers to first-trimester prenatal care initiation were frequently related to immigration status, such as psychosocial factors associated with fear of deportation, lack of insurance coverage, and the presence of socioeconomic factors such as lack of transportation and childcare to attend prenatal care visits.

The included articles used diverse research methodologies, with several using quasi-experimental designs to examine environmental factors such as Medicaid expansion and presumptive eligibility. Quasi-experimental designs are less susceptible to bias than cross-sectional studies because they exploit an exogenous exposure, such as Medicaid expansion, that effectively randomizes individuals into treatment and control groups (Hausman & Rapson, 2018). While only one of the included studies used this design (Camargo et al., 2023), mixed-methods may be a valuable methodology for better understanding interpersonal and environmental factors and how they affect first-trimester prenatal care initiation.

Several articles centered racial disparities in their studies, and most stratified results by race. Only two articles, however, assessed prenatal care timing in American Indian/Alaska Native women, a population known to have significant disparities in access to care and maternal and neonatal outcomes (Schmidt et al., 2023; Sebens & Williams, 2022). No articles centered Asian Americans, Native Hawaiians, or Pacific Islanders in the assessment of first-trimester prenatal care. More research is needed to understand specific needs of people in these communities, including research that takes into account the heterogeneity that exists in race and ethnicity. Improved data collection and disaggregation of findings by nativity and ethnicity can support a better understanding of the needs of these populations (Bane et al., 2022).

Overall, we found that the most impactful efforts towards promoting earlier entry to care were in the environmental domain, though these efforts were not equitable. Evidence from several articles indicated that immigrant populations, Hispanic women in particular, did not see benefits in prenatal care initiation from large-scale policy interventions such as Medicaid expansion or the Medicaid Primary Care Fee Bump, indicating that factors outside of insurance coverage play a significant role in first-trimester initiation. One structural barrier cited was the Public Charge Rule, which was associated with a decrease in early prenatal care initiation among uninsured immigrants and resulted in a chilling effect, causing immigrants to disenroll from public benefits (Choi et al., 2023). Camargo and colleagues (2023) identified other intrapersonal and interpersonal barriers, including a lack of proficient Spanish language interpreters, low prenatal care literacy, and transportation and childcare challenges. Given the current unfavorable policy environment towards immigrants and the growth of the immigrant population in the United States, targeting efforts to improve access to first-trimester care at the interpersonal and intrapersonal levels may yield more effective results. These efforts may facilitate improved care for undocumented immigrants who do not otherwise have access to insurance or non-emergency medical care. Community health clinics and free clinics, which offer free and low-cost care regardless of immigration status, may be an option for accessing prenatal care. Bolstering the quality of care and wraparound services and external funding mechanisms for free and/or community-based clinics can provide access to those who may not otherwise have a point of entry into the healthcare system. Longer-term, systemic changes to expand insurance coverage to immigrants, regardless of pregnancy, may yield more effective results by improving access to prenatal care.

We found that first-trimester prenatal care was defined inconsistently across studies. Some studies did not define the number of weeks gestation for which they defined first-trimester care. Others were more precise with their definition but used varying measures of gestational length to identify early care. The World Health Organization (2016) defines early prenatal care as initiated in the first 12 weeks of pregnancy while The American College of Obstetricians and Gynecologists (2017) considers the first trimester of pregnancy to include up to 14 weeks gestation. These varying definitions of prenatal care initiation may have implications for comparing results across studies and should be further evaluated. A systematic review conducted by Rowe et al. (2020) found similar measurement inconsistencies with indices of prenatal care utilization, including the commonly used Kotelchuck and Kessner Indices (Rowe et al., 2020). The authors recommended additional research to assess the validity, reliability, and responsiveness of measures of prenatal care utilization and agree upon the best approach for measuring prenatal care adequacy (Rowe et al., 2020). A standardized approach for measuring prenatal care timing may also provide more reliability in results and lead to more effective policy and practice solutions.

Only one study examined the impact of maternal opioid use disorder on prenatal care timing (Satcher et al., 2023). Given the magnitude of maternal mortality in the United States and its relationship with prenatal care utilization and substance use disorder, we feel this area warrants more exploration. Women in community supervision are at higher risk of substance use disorder, less likely to initiate early prenatal care, and more likely to experience adverse maternal and neonatal outcomes (Ellis et al., 2019). Satcher and colleagues found that women with criminal-legal involvement and opioid use disorder were more likely to engage in early care when they had stable housing, had been involved in community supervision, and were using buprenorphine at prenatal care initiation (Satcher et al., 2023). This study points to the need for more wraparound support at the community level and increased access to treatment options, especially in rural and underserved areas.

Limitations

One limitation of this study is the focus on first-trimester prenatal care initiation. We acknowledge that timing of initiation is only one component of quality prenatal care and does not provide insight into adequacy or outcomes. Because first-trimester initiation is only one aspect of adequacy, and this review's search strategy focused specifically on first-trimester care initiation, relevant papers that did not include prenatal care timing or first-trimester initiation among its primary outcomes may not have been included. We limited our inclusion criteria to only include papers that assessed prenatal care timing after the implementation of the ACA and Medicaid expansion. It is possible that papers that provided valuable insight into factors related to first-trimester prenatal care initiation that are persistent in nature, particularly factors unrelated to insurance status, were excluded.

2.5 Considerations for Future Research

Because our search identified only one paper that used a mixed-methods design, we recommend expanded use of qualitative and mixed-methods approaches that incorporate measures of first-trimester prenatal care to better understand the depth of barriers and facilitators related to first-trimester care initiation. This is especially important in immigrant populations as several articles pointed to persistent disparities in first-trimester prenatal care initiation, even among those with health insurance. Mixed-methods approaches can also provide more insight into barriers and facilitators of prenatal care timing in rural communities, which face growing challenges with access to care, and in the context of the interpersonal domain, which warrants further investigation.

2.6 Conclusion

Ensuring timely access to prenatal care will require comprehensive efforts that address factors related to first-trimester prenatal care at the intrapersonal, interpersonal, community, and societal levels. In order to ensure that all women have access to early prenatal care, the implementation of policies that can address persistent structural and systemic barriers that cause and exacerbate racial disparities will be required.

CHAPTER THREE: FACTORS RELATED TO EARLY PRENATAL CARE INITIATION IN A SAMPLE OF KENTUCKY WOMEN: A CROSS-SECTIONAL ANALYSIS OF PRAMS DATA (2017-2020)

3.0 Overview

OBJECTIVES: Early prenatal care is initiated in the first trimester, or first twelve weeks of pregnancy, and has been associated with improved maternal and neonatal outcomes. This study, guided by the Socioecological Model, aimed to identify predictors of early prenatal care in a sample of Kentucky women who gave birth between 2017 and 2020.

METHODS: This cross-sectional study used pooled data from Phase 8 of the Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS), a representative sample of all births that occurred in the state from 2017 to 2020. Timing of prenatal care initiation, the dependent variable, was derived from the PRAMS question, "How many weeks or months pregnant were you when you went for your first prenatal care visit?" Results from weighted linear and logistic regressions, including adjusted odds ratios and 95% confidence intervals, are reported.

RESULTS: The study sample consisted of 2,365 women, 88.9% of whom initiated prenatal care in the first twelve weeks of pregnancy. Factors with the strongest association with early prenatal care were no insurance (aOR: 0.169, 95% CI: 0.061, 0.468), pregnancy ambivalence (aOR: 0.561, 95% CI: 0.319, 0.988), less than high school education (aOR: 0.087, 95% CI: 0.033, 0.230), and urban residence (aOR: 1.630, 95% CI: 1.038, 2.561). Smaller but significant associations were found with WIC receipt, marital status, maternal age (35 years or older), and near poor household income. There were no statistically significant associations with early prenatal care and maternal race, number of previous live births, or birth year.

CONCLUSIONS: The results of this study provide a foundation for deeper exploration into structural and systemic factors that influence early prenatal care, including the rate of insurance churn and more nuanced analyses of maternal residence, race, immigrant status, and pregnancy intention.

KEYWORDS: Prenatal care, timing, PRAMS, Kentucky

3.1 Introduction

Prenatal care initiated in the first twelve weeks of pregnancy, or early prenatal care, is a contributing factor in decreasing maternal and perinatal morbidity and mortality (Barros et al., 1996; Nasiri et al., 2021). While the majority of pregnant women (88.9% in 2021) in the United States initiate prenatal care in the first trimester, there is substantial variation by sociodemographic factors (Martin & Osterman, 2023). Black (85.2%) and Hispanic (84.1%) women are less likely to initiate early prenatal care than White women (91.7%) (Martin & Osterman, 2023). Women with unintended pregnancies, Medicaid coverage, low socioeconomic status, and less education are also less likely to initiate early prenatal care (Cruz-Bendezú et al., 2020; Osterman & Martin, 2018). Women who initiate late or no prenatal care are at higher risk for adverse maternal outcomes. Among women with pregnancy-related deaths between 2011 and 2013, 24.5% had initiated prenatal care in the second or third trimester and 8.5% had not received any prenatal care (Howell, 2018).

Clinical guidelines from the American Academy of Pediatrics (AAP) and the American College of Obstetricians and Gynecologists (ACOG) recommend that prenatal care begin in the first trimester of pregnancy and continue regularly at a frequency based upon the needs of the pregnant woman (The American College of Obstetricians and Gynecologists, 2017). Early prenatal care includes risk counseling, review of family history and genetics testing options, education, referrals to needed services such as smoking cessation, and more. Early initiation provides opportunities to identify and treat potential risks to the woman and/or fetus, create a comprehensive plan for care throughout pregnancy, and prepare for labor and delivery.

In 2023, March of Dimes reported an increasing number of maternity care deserts across the United States. A maternity care desert is defined as a county with no hospital or birth center and no obstetric providers (March of Dimes, 2023b). Rural states have been disproportionately impacted by the loss of access to maternity care which has been exacerbated in recent years by the COVID-19 pandemic (Gjesfjeld & Jung, 2011; Lee & Singh, 2023). In 2022, 45.8% of Kentucky counties were considered maternity care deserts, compared to 32.6% of counties in the United States (March of Dimes, 2023b).

There are no known studies of factors related to early prenatal care specific to women in Kentucky, a predominately rural state that has been disproportionately impacted by maternity care shortages and poor maternal outcomes compared to other states across the country. At 39.7 deaths per 100,000 live births between 2018 and 2020, Kentucky has one of the highest maternal mortality rates in the country (Hoyert, 2023). In its most recent report, the Kentucky Maternal Mortality Review Committee determined that 91% of maternal deaths in the state were preventable and that, among all deaths, 47% had fewer than four prenatal care visits (Kentucky Department for Public Health, 2022). While national or regionally focused studies that include Kentucky in their analyses provide important information regarding drivers of early prenatal care, a state-level study can directly contribute to the development of local policy and practice solutions to improve outcomes for women and infants.

The Socioecological Model (SEM) provides a framework for systematically assessing factors associated with early prenatal care through the lens of a dynamic, systems-based approach (Stokols, 1996). This model acknowledges the interrelationships between an individual, their behaviors and outcomes, and the external environment through a multi-faceted approach that includes influences in the intrapersonal, interpersonal, community, and societal domains. The intrapersonal domain includes genetics, personality dispositions, individual characteristics, and an individual's health practices (Stokols, 1996). The interpersonal domain describes social connections and relationships with others such as family, friends, and work colleagues. The community domain recognizes the physical, social, and cultural dimensions of one's environment such as geography and built environment (Stokols, 1996). Social and cultural norms and structural factors, including health, economic, and educational policies that have historically segregated marginalized communities, are included in the societal domain of the SEM (Centers for Disease Control and Prevention, 2022b). Each of these domains is important to consider when developing or assessing comprehensive strategies to address the timing of prenatal care initiation.

The objective of this cross-sectional analysis was to identify predictors of early prenatal care among women in Kentucky who gave birth between 2017 and 2020, using the SEM as a framework. Additionally, studies have traditionally assessed pregnancy intent as "unintended", "intended", or "mistimed" though evidence suggests that understanding intent requires a more nuanced approach (Kost et al., 2021). This analysis incorporated pregnancy ambivalence to assess a more nuanced relationship of pregnancy intent with early prenatal care.

3.2 Methods

Study Design and Data Source

This study was a cross-sectional analysis using pooled data from Phase 8 (2017-2020) of the Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS), reported using guidelines from Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (von Elm et al., 2014) (Appendix Table 3). This study used de-identified secondary data and was determined to be exempt by the University of Louisville Institutional Review Board.

PRAMS is a state-level, population-based surveillance effort conducted in partnership between the Centers for Disease Control and Prevention (CDC) and state health departments. PRAMS uses a mixed-mode survey (telephone and mail) and collects data related to maternal behaviors and experiences before, during, and after pregnancy (Shulman et al., 2018). The purpose of PRAMS is to provide a standardized methodology to collect, analyze, and disseminate population-based data that can support the development of data-driven practice and policy to improve maternal and infant health (Shulman et al., 2018).

PRAMS uses a stratified random sampling methodology and draws from the site's birth certificate records. Sample stratification allows PRAMS sites to oversample subpopulations of women based upon their priorities. The sample consists of women who have had a livebirth in the previous two to six months. PRAMS data are weighted to project population-based estimates and accounts for sample design, non-response, and noncoverage. PRAMS survey responses are linked to the site's birth certificate records, making it a rich source of data to understand maternal experiences and outcomes (Shulman et al., 2018). Kentucky began collecting PRAMS data in 2017 and has data available through 2020 (Kentucky Department for Public Health, 2018). The 2021 Kentucky PRAMS data is not available due to a response rate (45.5%) that did not meet the 50% threshold required by the CDC (Centers for Disease Control and Prevention, 2023a).

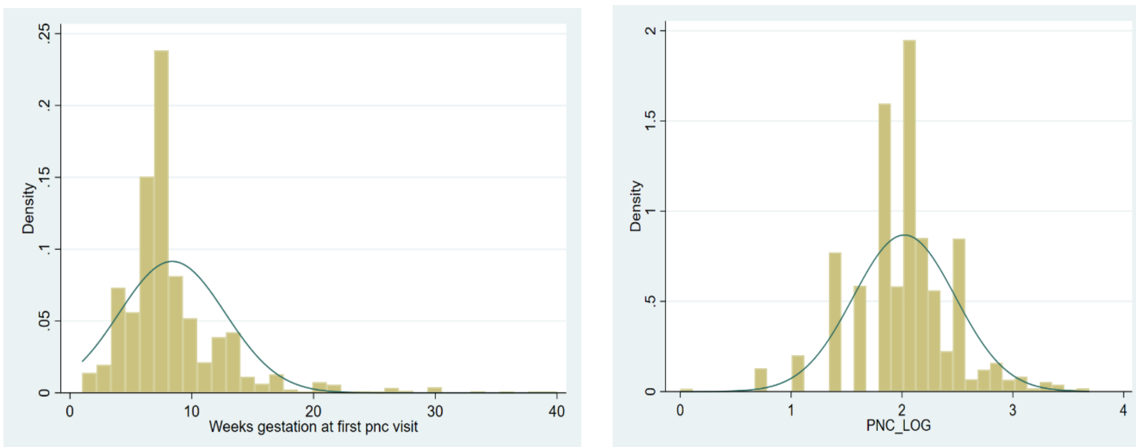
Sample

Between 2017 and 2020, 5,780 (unweighted) women were sampled to participate in Kentucky PRAMS, and a total of 3,172 responded for an overall response rate of 54.5%. Due to potential disruptions in prenatal care that could have impacted the timing of initiation, women who gave birth on or after March 6, 2020, were excluded from the study sample (n=668). This was the date on which Kentucky's governor declared a state of emergency related to COVID-19 (Commonwealth of Kentucky, 2020). Women who did not receive any prenatal care were excluded from the sample (n=12). Listwise deletion was used to eliminate observations with missing data for the dependent and independent variables. The final unweighted analytic sample for this study was 2,365, which provided a weighted sample representing 142,289 births during the study period. The construction of the analytic sample is illustrated in Figure 3.Figure 3. Sample Selection Flow Chart

Dependent Variable

The primary outcome for this study was the week of pregnancy when prenatal care was initiated, which was derived from the PRAMS question, "How many weeks or months pregnant were you when you went for your first prenatal care visit?" The CDC converts all responses to this question into weeks gestation at initiation prior to disseminating data to sites. The range of this variable was 1-40 weeks. For the logistic regression, a binary variable was created where early prenatal care was defined as initiation before week 13 of pregnancy and late care was defined as initiation at week 13 or later (World Health Organization, 2016).

Figure 2. Histograms of Level and Log-Transformed Dependent Variable



Selection of Independent Variables

Initial selection of independent variables was guided by the domains of the SEM, informed by the current body of literature related to prenatal care timing and utilization, and informed by a series of bivariate regressions (Harvey et al., 2021; Julceus et al., 2023; Sebens & Williams, 2022; Stokols, 1996). To identify the final set of independent variables to be used in the regression models, a series of linear regressions to assess the bivariate association of each of the following variables with the dependent variable was conducted: maternal race, maternal age, maternal education, household income, marital status, WIC receipt during pregnancy, pregnancy intention, insurance used for prenatal care, previous live births, maternal residence, pre-pregnancy diabetes, hypertension, and depression, maternal BMI, and maternal smoking. The inclusion of pre-pregnancy diabetes, hypertension, depression, maternal BMI, and maternal smoking were found to have little to no effect on the coefficient of the independent variables and/or exhibited characteristics of multicollinearity and were, therefore, excluded from the analysis. After removing these, a series of linear regressions was conducted with the remaining variables to assess fit and predictability power. The same independent variables were included in both linear and logistic regressions to maintain consistency. The alignment of the final list of selected independent variables with the SEM is described in Table 4.

Table 4. Listing of Independent Variables in the Final Analysis

Socioecological Model Domain	Independent Variables
Intrapersonal	Prenatal Care Health Insurance Maternal Education Pregnancy Intention Maternal Age Maternal Race Previous Live Births Household Income
Interpersonal	Marital Status
Community	Maternal Residence
Societal	WIC

Intrapersonal Domain

Intrapersonal domain variables included biological and demographic characteristics that influence an individual's behaviors, attitudes, knowledge, and perception (Stokols, 1996). Due to limitations in the PRAMS data, the majority of independent variables for this analysis were in the intrapersonal domain of the SEM. Independent variables in the final models included those derived from Kentucky birth certificates and PRAMS data. Intrapersonal domain independent variables included maternal education (less than high school, high school, some college, college graduate or higher), maternal age (less than 20 years, 20-24 years, 25-29 years, 30-34 years, and 35 years or more), number of previous live births (none, one, two or more), and maternal race, all of which were derived from birth certificates. While the birth certificate can be a rich source of data on race and ethnicity, 90% of the Kentucky PRAMS sample was either Black or White. Categories of Black and White were retained in the final analysis and all other races were aggregated into a category of “Other.”

Independent variables in the intrapersonal domain from the PRAMS survey included household income, prenatal care health insurance, and pregnancy intention. Two variables from the PRAMS survey were used to construct a variable that reflected the household income of an individual, in relation to the federal poverty level (FPL) in the year before their baby’s birth. This variable was constructed from two questions on the PRAMS survey, “During the 12 months before your new baby was born, what was your yearly total household income before taxes?” and “During the 12 months before your new baby was born, how many people, including yourself, depended on this income?” Yearly total household income is collected as a categorical variable on the PRAMS survey. The mid-point of each income category was taken to be the household income. Next, the number of dependents in the household was used-to calculate the household income as a function of FPL. A categorical variable was created to report income as a percentage of the FPL. The categories (Poor, Near Poor, Low Income, Middle/High Income) for the final variable were modeled after a similar variable from the Medical Expenditure Panel Survey (Agency for Healthcare Research and Quality, 2009). The following categorization was used in the analysis: Poor (0-99% FPL), Near Poor (100%-125% FPL), Low Income (125-199% FPL), Middle/High Income (200% and above FPL). Due to a small number of observations (n=3) in the “High Income” category, “Middle Income” and “High Income” were combined.

Prenatal care health insurance was derived from the PRAMS question, “During your most recent pregnancy, what kind of health insurance did you use for prenatal care?”

Three categories (“Private health insurance from my job or the job of my husband or partner”, “Private health insurance from my parents,” and “Private health insurance from the Health Insurance Marketplace”) were collapsed into “Private.” Those with Medicaid remained in the “Medicaid” category and those with no insurance were grouped into “No Insurance.”

Pregnancy intention was derived from the PRAMS question, “Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant?” The options for this question were “I wanted to be pregnant later”, “I wanted to be pregnant sooner”, “I wanted to be pregnant then”, “I didn’t want to be pregnant then or at any time in the future”, “I wasn’t sure what I wanted.” To assess the relationship between early prenatal care and pregnancy ambivalence, the original PRAMS categories were retained as is in the analysis, rather than collapsing the options into “intended”, “unintended”, and “mistimed” pregnancy, as is traditionally done in other studies.

Interpersonal Domain

The interpersonal domain of the SEM included formal and informal social networks and relationships such as those with friends, family, and co-workers (McLeroy et al., 1988). Marital status, derived from the birth certificate, was selected as an interpersonal variable for this study because of its potential to influence early prenatal care initiation. The infant’s birth certificate reports marital status as “Married” or “Other.” This categorization was retained but renamed from “Other” to “Not Married.”

Community Domain

The community domain of the SEM describes relationships between organizations, institutions, and informal networks and describes geographical and political attributes of a place (McLeroy et al., 1988). Maternal residence was included in the analysis as a community domain variable. Maternal residence is derived from the birth certificate as a dichotomous variable (urban/rural). PRAMS is a state-level survey and does not include granular indicators of residence such as county or zip code.

Societal Domain

This broad category of the SEM includes structural factors such as policies, laws, and regulations that protect the health of individuals and communities (McLeroy et al., 1988). One variable, receipt of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), was included in the societal domain. WIC is a federal program that provides supplemental foods, health care referrals, and nutrition education to pregnant and postpartum women with low-income (United States Department of Agriculture, 2024). This variable was derived from the birth certificate and is a dichotomous (yes/no) variable.

Data Analysis

Descriptive statistics were generated for the analytic sample and independent variables used in the analyses and were stratified by early or late prenatal care. Early prenatal care was defined as care that was initiated before week 13 of pregnancy. Non-weighted frequencies and weighted percentages were calculated for each independent variable. Weighted averages for the week gestation of prenatal care initiation and total number of prenatal care visits for the overall sample and by early or late initiation were calculated. The analysis used both linear and logistic regression models to estimate the association of the independent variables with the dependent variable (week of initiation of prenatal care). The logistic model allowed for the estimation of adjusted odds ratios (aOR) while the linear regression was included to assess the magnitude of the association of the independent variables with the dependent variable. For bivariate analyses, weighted Chi-square tests were conducted, and p-values are reported in the Appendix. To avoid compositional effect, the subpopulation used in the bivariate analyses was maintained, which included BMI, maternal smoking, pre-pregnancy depression, pre-pregnancy hypertension, and pre-pregnancy diabetes. While these variables were not included in the final regression models, any observations with missing values in any of these variables were excluded from the final subpopulation. All analyses were weighted using PRAMS survey weights, which account for the complex stratified survey design, noncoverage, and nonresponse (Shulman et al., 2018). All analyses used Stata's "svy" suite of commands (StataSE, Version 17) to project population-level estimates and account for the survey design. The "subpop" command in Stata was used to accurately assess variance estimates in the analyses. The analysis used de-identified data and was exempt from review by the University of Louisville's Institutional Review Board.

3.3 Results

A total of 2,365 women in the Kentucky PRAMS sample gave birth between January 1, 2017, and March 5, 2020, and received any prenatal care, which constituted the analytic sample (Figure 3). Women excluded from the analysis because they did not receive any prenatal care (n=12) were more likely to be Black (n=9), poor (n=7), have less than a high school education (n=4), and have public insurance (n=4) or a missing value for insurance (n=5). The final weighted analytic sample represents 145,289 births during the study period. In weighted analyses, 88.9% of women initiated early prenatal care, and 11.3% initiated late prenatal care. This was similar to the overall PRAMS sample for the study period where 88.4% of women received early prenatal care. The weighted mean gestational week of initiation for those receiving early prenatal care was 7.2 (Standard Deviation (SD) =2.2) and 17.3 (SD=5.9) for those receiving late prenatal care. The weighted mean number of visits for the overall sample was 15.9 (SD=18.2). Women initiating early prenatal care had more visits than those initiating late care: 16.3 (SD=18.1) vs. 12.7 (SD=18.6).

Women who initiated early prenatal care were more likely to have private insurance (48.2% vs. 19.2%, p<0.001) while those with no prenatal care health insurance (n=41) were more likely to be White (n=24), Hispanic (n=14), 30-34 years old (n=14), have less than a high school education (n=23), be poor (n=13) or near poor (n=9), and have an urban residence (n=27). Women who initiated early care were more likely to have a college education or higher (32.2% vs. 5.4%, p<0.001), indicated they wanted to be pregnant at the time of pregnancy (43.5% vs. 26.2%, p<0.001), be married (62.9% vs. 37.1%, p<0.001), live in a middle to high income household (44.5% vs. 14.0%, p<0.001), be White (84.7% vs. 74.6%, p=0.0064), and report no previous live births (38.5% vs. 31.2%, p=0.001). There were no differences in WIC receipt, maternal age, maternal residence, or birth year. Characteristics of the sample can be found in Table *5*.

Figure 3. Sample Selection Flow Chart

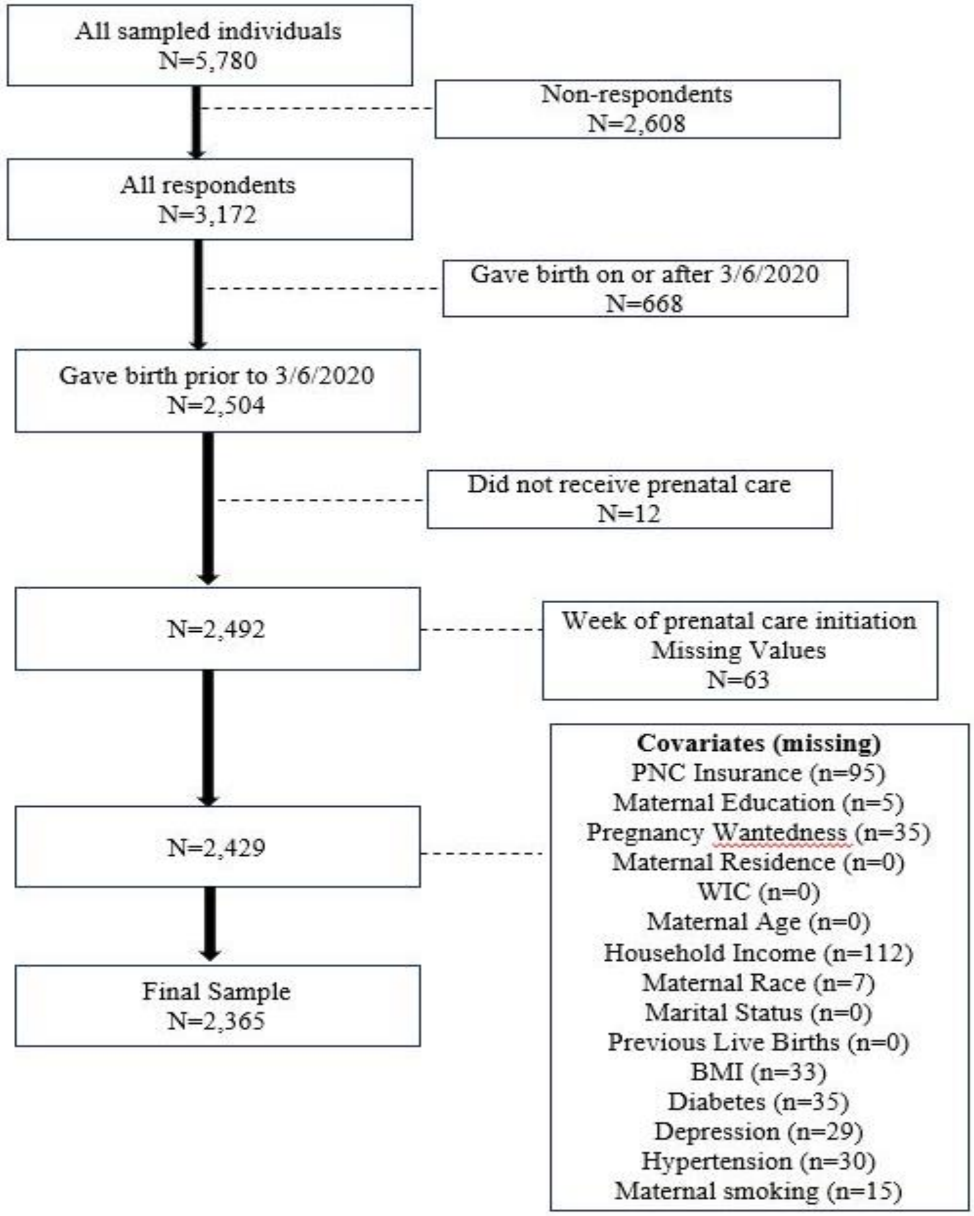


Table 5. Sample Characteristics, Kentucky PRAMS (2017-2020), Unweighted Frequencies and Weighted Percentages*

Characteristics	Total Sample N=2,365 (100%)	Early PNC N=2,082 (88.9%)	Late PNC N=283 (11.1%)	p-value**
Week of Prenatal Care Initiation, Weighted Mean (SD)	8.3 (4.2)	7.2 (2.2)	17.3 (5.9)	-
Number of Prenatal Care Visits Weighted Mean (SD)	15.9 (18.2)	16.3 (18.1)	12.7 (18.6)	-
Prenatal Care Health Insurance				<0.001
No Insurance	41 (2.6)	25 (1.6)	16 (11.0)	
Private	938 (44.9)	884 (48.2)	54 (19.2)	
Medicaid	1,291 (48.8)	1,099 (47.1)	192 (62.5)	
Missing	95 (3.7)	74 (3.2)	21 (7.3)	
Maternal Education				<0.001
Less than High School	245 (12.0)	174 (9.0)	71 (35.7)	
High School	691 (29.2)	601 (28.7)	90 (33.7)	
Some College (No Degree)	806 (29.2)	709 (30.1)	97 (22.6)	
College Graduate or Higher	618 (29.2)	596 (32.2)	22 (5.4)	
Missing	5 (0.4)	2 (0.09)	3 (2.6)	
Pregnancy Intention				<0.001
Wanted Later	540 (19.5)	462 (19.2)	78 (21.4)	
Wanted Sooner	282 (14.0)	261 (14.5)	21 (10.1)	
Wanted Then	866 (41.6)	807 (43.5)	59 (26.2)	
Didn't Want Then or Anytime	221 (7.0)	166 (6.0)	55 (15.6)	
Unsure What I Wanted	421 (16.7)	356 (15.6)	65 (25.6)	
Missing	35 (1.3)	30 (1.3)	5 (1.1)	
Maternal Residence				0.2487
Urban	1,693 (58.8)	1,476 (58.3)	217 (63.4)	
Rural	672 (41.2)	606 (41.8)	66 (36.6)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	
WIC				0.1125
Yes	1,319 (58.6)	1,184 (59.3)	135 (52.4)	
No	1,046 (41.4)	898 (40.7)	148 (47.6)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	
Maternal Age				0.148
<20 years	162 (6.9)	128 (6.4)	34 (11.6)	
20-24 years	600 (23.5)	518 (23.2)	82 (26.6)	
25-29 years	720 (31.3)	639 (31.7)	81 (27.7)	
30-34 years	576 (25.0)	517 (25.3)	59 (22.0)	
>=35 years	307 (13.3)	280 (13.5)	27 (12.1)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	
Household Income				<0.001
Poor	818 (30.6)	664 (28.1)	154 (50.3)	
Near Poor	202 (8.6)	167 (7.7)	35 (15.3)	
Low Income	390 (15.7)	350 (15.9)	40 (14.3)	
Middle/High Income	843 (41.1)	809 (44.5)	34 (14.0)	
Missing	112 (4.0)	92 (3.8)	20 (6.1)	
Maternal Race				0.0064
White	1,252 (83.6)	1,148 (84.7)	104 (74.6)	
Black	864 (9.0)	723 (8.4)	141 (13.7)	

Characteristics	Total Sample N=2,365 (100%)	Early PNC N=2,082 (88.9%)	Late PNC N=283 (11.1%)	p-value**
Other	242 (6.9)	206 (6.5)	36 (10.0)	
Missing	7 (0.6)	5 (0.4)	2 (1.7)	
Marital Status				<0.001
Not Married	1,198 (40.0)	1,003 (37.1)	195 (62.9)	
Married	1,167 (60.0)	1,079 (62.9)	88 (37.1)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	
Previous Live Births				0.001
None	890 (37.7)	796 (38.5)	94 (31.2)	
One	738 (31.8)	667 (32.9)	71 (23.0)	
Two or More	737 (30.5)	619 (28.6)	118 (45.8)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	
Birth Year				0.6312
2017	660 (32.9)	576 (32.7)	84 (34.8)	
2018	709 (32.2)	619 (32.5)	90 (30.3)	
2019	869 (29.6)	774 (29.4)	95 (31.6)	
2020	127 (5.3)	113 (5.5)	14 (3.4)	
Missing	0 (0.0)	0 (0.0)	0 (0.0)	

*Percentages are weighted to account for sample design, nonresponse, and noncoverage.
**p-value is a weighted estimate.
†Estimates with 50 or fewer observations may not be generalizable.

Table 6. Linear and Logistic Regression Results presents estimates for results from weighted linear and logistic regressions, adjusted for all independent variables and stratified by early or late prenatal care initiation. The most substantial variation was observed in prenatal care health insurance, maternal education, and pregnancy intention. In the unadjusted linear regression, a delay of 4.6 weeks in initiation of prenatal care among those without prenatal care health insurance was observed, relative to those with private insurance (Appendix Table 15). In the adjusted model, women with no insurance initiated prenatal care approximately 3.0 weeks later than those who had private insurance (95% Confidence Interval, CI: 0.7, 5.3). As education increased, women were more likely to initiate care in earlier weeks of pregnancy. Those with less than a high school education initiated care 2.3 weeks later than those with college or higher (95% CI: 0.901, 3.725). Compared to women who reported they wanted their pregnancy then, women who reported not wanting to be pregnant then or anytime initiated care 1.17

weeks later (95% CI: 0.166, 2.174). Women residing in rural areas initiated care 0.587 weeks, or approximately 4 days, earlier than those living in urban areas (95% CI: -1.078, -0.095). WIC receipt was also associated with earlier prenatal care (95% CI: -1.443, -0.033). A marginally statistically significant association was found with maternal age of 35 years or more (95% CI: -1.177, 0.051). No statistically significant associations were observed for household income, maternal race, marital status, previous live births, or year of infant birth.

In the adjusted logistic regression, women with no insurance were 83.1% (95% CI: 0.061, 0.468) less likely to receive early prenatal care compared to those with private insurance and experienced a delay of three weeks. The odds of receiving early prenatal care decreased with decreasing levels of education, relative to those with college or higher. Women with less than a high school education were the least likely to receive early prenatal care (95% CI: 0.033, 0.230). Women who reported not wanting to be pregnant at the time of pregnancy or anytime were 65.9% less likely to receive early prenatal care compared to women who wanted to be pregnant then (95% CI: 0.171, 0.678) while those who were not sure what they wanted were 43.9% less likely (95% CI: 0.319, 0.988). WIC recipients were more likely to receive early prenatal care (95% CI: 1.029, 2.587) as were women living in rural areas (95% CI: 1.038, 2.561) and married women (95% CI: 1.004, 2.818). Related to household income, those living in near poor households reported a 61% decreased likelihood of receiving early prenatal care compared to those in middle/high income households (95% CI: 0.163, 0.934). Regarding maternal age, only one category, 35 years and older, was marginally significantly associated with early prenatal care (aOR: 1.528, 95% CI: 0.778, 3.002). No statistically significant associations were found with maternal race, previous live births, or birth year.

Table 6. Linear and Logistic Regression Results

Independent Variables	Dependent/Outcome Variable Week Number of Prenatal Care Initiation Linear Model	Late Prenatal Care (0) vs. Early Prenatal Care (1) Logistic Model Adjusted Odds Ratios
Prenatal Care Health Insurance (Ref: Private)		
No Insurance	3.001**	0.169***
	(0.696, 5.306)	(0.061, 0.468)
Medicaid	0.202	0.755
	(-0.546, 0.949)	(0.397, 1.434)
Maternal Education (Ref: College or Higher)		
Less than High School	2.313***	0.087***
	(0.901, 3.725)	(0.033, 0.230)
High School Graduate	0.378	0.213***
	(-0.377, 1.132)	(0.091, 0.500)
Some College	-0.038	0.314***
	(-0.530, 0.454)	(0.144, 0.686)
Pregnancy Intention (Ref: Wanted to be Pregnant Then)		
Wanted to be pregnant later	0.494	0.863
	(-0.184, 1.173)	(0.489, 1.525)
Wanted to be pregnant sooner	0.172	0.555
	(-0.417, 0.761)	(0.273, 1.128)
Didn't want to be pregnant then or anytime	1.170**	0.341***
	(0.166, 2.174)	(0.171, 0.678)
I wasn't sure what I wanted	0.639	0.561**
	(-0.208, 1.487)	(0.319, 0.988)
Maternal Residence (Urban/Rural) (Ref: Urban)	-0.587** (-1.078, -0.095)	1.630** (1.038, 2.561)
WIC (Ref: No)	-0.738**	1.632**
	(-1.443, -0.033)	(1.029, 2.587)
Maternal Age (Ref: 25-29)		
<20 Years	-0.071	1.134
	(-1.247, 1.105)	(0.481, 2.674)
20-24 Years	-0.359	1.293
	(-1.093, 0.374)	(0.745, 2.244)
30-34 Years	0.245	0.788
	(-0.355, 0.845)	(0.455, 1.363)
>=35 Years	-0.563*	1.528
	(-1.177, 0.051)	(0.778, 3.002)
Household Income (Ref: Middle/High Income)		
Poor	0.628	0.584
	(-0.367, 1.623)	(0.254, 1.342)
Near Poor	0.855	0.390**
	(-0.252, 1.962)	(0.163, 0.934)
Low Income	0.327	0.738
	(-0.476, 1.131)	(0.326, 1.673)

Maternal Race (Ref: White)		
Black	0.065	0.961
	(-0.493, 0.624)	(0.651, 1.419)
Other	-0.507	1.238
	(-1.777, 0.764)	(0.623, 2.460)
Marital Status (Ref: Not Married)	-0.331	1.682**
	(-0.998, 0.337)	(1.004, 2.818)
Previous Live Births (Ref: None)		
One	-0.299	1.230
	(-0.848, 0.251)	(0.714, 2.121)
Two or More	0.257	0.890
	(-0.518, 1.031)	(0.495, 1.600)
Year of Infant Birth (Ref: 2017)		
2018	-0.162	1.077
	(-0.762, 0.438)	(0.665, 1.743)
2019	-0.232	0.942
	(-0.806, 0.342)	(0.592, 1.500)
2020	-0.339	1.627
	(-1.352, 0.674)	(0.523, 5.068)

p-values are significant at p<0.01***, p<0.05**, p<0.1*. Lower and upper bounds of 95% confidence intervals in parentheses.

3.4 Discussion

Using pooled Kentucky PRAMS data from 2017 to 2020 we found that, while most women initiated early prenatal care, there were significant sociodemographic disparities in early compared to late initiation. We also found a statistically significant association between the timing of prenatal care initiation and pregnancy ambivalence. The SEM was used as a framework to examine differences in early and late prenatal care initiation across sociodemographic factors. Due to limitations of the Kentucky PRAMS data, findings are primarily focused on the intrapersonal domain of the SEM.

The most significantly associated predictors of early versus late prenatal care initiation in this study were prenatal care health insurance, pregnancy intention, and maternal education. Relative to private insurance coverage, those with no insurance experienced a delay of three weeks in initiating prenatal care. In 2014, Kentucky expanded Medicaid under the Affordable Care Act (ACA), which extended coverage to childless adults between the ages of 19-64 with an income up to 138% of the federal poverty level (FPL). Pregnant women are eligible up to 200% of the FPL. Research has found that, while the ACA expanded coverage to reproductive-aged women in Medicaid expansion states, reduced uninsurance, and improved continuity of coverage in the perinatal period, high rates of insurance churn have persisted (Daw et al., 2020). One study found that rates of uninsurance were highest in the month before conception and lowest at delivery, suggesting that women are enrolling in Medicaid during their pregnancy rather than in the preconception period (Daw et al., 2020). Insurance churn, particularly in the preconception and prenatal periods, contributes to delays in recommended prenatal care (Admon et al., 2021). Previous studies have found that the complexity of completing Medicaid paperwork is an additional contributor to late initiation of prenatal care (Camargo et al., 2023). Expanding preconception Medicaid coverage and simplifying the process of applying for Medicaid coverage may facilitate earlier entry to prenatal care among women in Kentucky.

In Kentucky, presumptive eligibility for Medicaid is available for pregnant women who are residents of the state and meet income guidelines (Kentucky Cabinet for Health and Family Services). Presumptive eligibility allows pregnant women to receive prenatal care through Medicaid for up to 60 days while eligibility for Medicaid is determined. Despite the availability of presumptive eligibility in Kentucky, the study sample included women who reported no prenatal care health insurance. Studies have found that disparities in early prenatal care persist even after presumptive eligibility implementation, particularly among women with low educational attainment (Eliason &

Daw, 2022). Awareness of presumptive eligibility or knowledge of how or where to apply may be a barrier to public insurance coverage during pregnancy. In this study's sample, the uninsured were more likely to be Hispanic and live in a poor or near poor household. Research has identified persistent disparities in early or any prenatal care receipt among immigrants for a number of reasons, including Medicaid exclusions for immigrants (Camargo et al., 2023; Janevic et al., 2022). In 2022, Kentucky began using federal funds to cover prenatal care for authorized immigrants who were in the United States legally. Prior to 2022, Kentucky implemented the five-year ban that barred most authorized immigrants from receiving public services, including Medicaid (Kaiser Family Foundation, 2023). Because the Kentucky PRAMS dataset does not include births after December 2020, the findings from this study do not reflect changes in public insurance coverage for pregnant women that occurred in 2022.

While there was not a statistically significant association between Medicaid coverage and the timing of prenatal care initiation, a larger proportion of women with Medicaid coverage for their prenatal care (62.5%) reported initiating late prenatal care. Women with Medicaid coverage report challenges in finding providers in their community who will accept their insurance while providers report unwillingness to accept Medicaid due to complex administrative paperwork, billing procedures and low reimbursement rates (Bellerose, Collin, & Daw, 2022; Reid et al., 2021). Women who have Medicaid coverage are also more likely to experience socioeconomic barriers such as lack of access to transportation, childcare challenges, and are more likely to report experiences of discrimination based on race or insurance status (Bellerose, Rodriguez, & Vivier, 2022).

The finding that maternal education is a significant predictor of early prenatal care aligns with a large body of existing research (Baer et al., 2019; D'Ascoli et al., 1997). Women in this study with less than a high school education delayed initiation of care by 2.3 weeks relative to college graduates or higher. Because this analysis did not stratify timing by maternal education, it is not possible to identify the variation in determinants of timing based upon educational attainment. Existing research indicates that women with low educational attainment are more likely to be low-income and eligible for Medicaid (Eliason & Daw, 2022). Changes to insurance policy have been shown to be effective in increasing rates of early prenatal care among women with low educational attainment. Eliason and Daw (2022) found that the implementation of presumptive eligibility for pregnant women in Kansas resulted in small but significant increases in early prenatal care among women with less than a high school education. The study also found that, while there were increases in timely care, nearly 25% of women with low maternal education did not receive first trimester prenatal care, even after presumptive eligibility was implemented. Similarly, our study found that women in near poor households (100-120% FPL) were much less likely to initiate early prenatal care, compared to those in middle/high income households, though many were eligible for Medicaid. This evidence reinforces the importance of preconception insurance coverage and points to other barriers to early prenatal care initiation that may be associated with having a low income.

The finding that pregnancy intention is strongly associated with early prenatal care aligns with a robust body of research that has found delays in care among women with an unintended pregnancy (Cruz-Bendezú et al., 2020; Dibaba et al., 2013; Nepal et al., 2011). Not knowing about the pregnancy until after the first trimester, or when symptoms present more clearly, can result in delays in seeking care. This study retained the original response categories available to PRAMS survey respondents to test whether pregnancy ambivalence was associated with early prenatal care. We found that pregnancy ambivalence was associated with a 43.9% reduction in the likelihood of early prenatal care. Traditionally, studies have collapsed the PRAMS response "I wasn't sure what I wanted" into the "unintended" category. Our findings suggest that grouping pregnancy ambivalence with unintended or unwanted pregnancy may mask important variations in early prenatal care initiation.

At the interpersonal level of the SEM, marital status was found to be positively associated with early prenatal care, a finding that aligns with other research (Blakeney et al., 2019; Egerter et al., 2002; Krukowski et al., 2022). Because unmarried women are more likely to have an unintended pregnancy than married women, and unintended pregnancy has implications for early prenatal care initiation, this association merits further investigation (Guttmacher Institute, 2019).

In the community domain of the SEM, this study found that women residing in rural areas were slightly more likely to initiate early care than those living in urban areas. This finding does not align with other research that has found that women living in rural areas are more likely to experience delays in care as a result of living in maternity care deserts (Kennedy et al., 2022; March of Dimes, 2023b). At least one study has found evidence that distance traveled to a maternity care provider may be more influential in the timing of care than the rurality of the county of residence (Kennedy et al., 2022). This finding merits further investigation using research methods and data sources that can provide a more contextual understanding of the association between geography and prenatal care timing. Limitations of the Kentucky PRAMS dataset do not allow for the analysis of zip code or neighborhood-level factors associated with delayed prenatal care.

WIC receipt was included as a societal domain variable and found to be associated with earlier prenatal care initiation by nearly two weeks. This finding should be interpreted with caution due to the inconsistent association of WIC observed in the bivariate linear regression in the sample. The impact of WIC on prenatal care timing has been observed in previous research and provides further evidence of the importance of large-scale policies in increasing access to care for low-income women (Blakeney et al., 2019; Krukowski et al., 2022). In addition to providing supplemental food to low-income women and infants, the WIC program provides screening and referral support for needed health and social services (United States Department of Agriculture, 2024). A recent qualitative study in North Carolina found that women enrolled in WIC had overall positive perceptions of the program and found it to be a source of social support (Barnes et al., 2023).

Smaller but statistically significant associations were found in maternal age older than 35 and near poor household income. No statistically significant associations were found between early prenatal care and maternal race, the number of previous live births, or birth year. In the bivariate analyses, there was a strong relationship between maternal race and early prenatal care, but this association disappeared after controlling for other factors. There is substantial evidence that maternal race has an impact on early prenatal care initiation with clear disparities among women of color (Bryant et al., 2010). Future analyses that stratify by maternal race are needed to more closely examine this factor.

This study confirms much of what is known regarding intrapersonal factors related to early prenatal care initiation. Kentucky PRAMS does not currently collect information regarding barriers to prenatal care though the inclusion of this question is an option that the CDC provides to states. An additional option for inclusion in the Kentucky survey is the PRAMS question related to whether the respondent is satisfied with the timing of their prenatal care. Including these questions in future PRAMS surveys can shed light on structural and systemic barriers that can support the development of more holistic approaches to improving early prenatal care initiation among women in Kentucky.

Limitations

The results of this study should be understood in the context of its limitations. The small sample size limited the ability to obtain stable estimates for all covariates. Small sample sizes and missing data did not allow for the inclusion of potentially important variables like language or nativity. The omission of these variables in the analysis may have produced bias in the results, likely leading to an underestimation of their associations with early prenatal care initiation. Future studies of Kentucky PRAMS would benefit from larger sample sizes, which may be facilitated by increased efforts at the state and community levels to improve response rates. PRAMS data, and linked birth certificates, have several limitations including recall and self-report bias, which may result in measurement error. This was a cross-sectional study and cannot establish causality. The use of quasi-experimental studies can greatly reduce bias and provide more insight into causal factors.

3.5 Considerations for Future Research

The findings of this study shed light on several factors that warrant a deeper exploration of their impact on early prenatal care, including insurance churn, immigration status, and pregnancy intention. A future study of early prenatal care should stratify analyses by maternal race to identify potential disparities that exist in access to care among women in Kentucky by race. This approach will provide a more precise understanding of the role of race in early prenatal care initiation, particularly because of the confounding effects of race with other covariates that were used in the analysis such as maternal education and household income. Further exploration of this relationship is important given the magnitude of maternal mortality in Kentucky and its disproportionate impact on Black women.

Future studies that stratify analyses by maternal residence may be valuable in understanding variations in prenatal care timing by rurality. The inclusion of zip code, or other geographic identifiers, would allow for a more comprehensive analysis of the relationship between community-level factors and timing of prenatal care.

Future analyses that stratify data by pregnancy intention can support a better understanding of the characteristics of women who may be ambivalent about pregnancy. Additionally, the inclusion of PRAMS variables related to contraceptive use prior to pregnancy and birth spacing in future analyses can support a more holistic understanding of pregnancy intention.

Early prenatal care initiation is one component of quality care. Future research into patterns of prenatal care utilization, adequacy of care, quality from the perspective of women in Kentucky, and birth outcomes are needed. The use of mixed-methods approaches can provide a deeper understanding of contextual factors that contribute to delayed or no prenatal care and the association with birth outcomes.

While we did not examine the prevalence or impact of insurance churn in this study, Kentucky PRAMS data provides an opportunity to do so. A study of insurance churn, especially as it relates to low-income women and those with Medicaid coverage, may provide additional insights into the impact of insurance churn on early prenatal care initiation among women in Kentucky.

3.6 Conclusion

This is the first study that we are aware of that analyzes factors associated with early prenatal care with a focus on Kentucky and that includes pregnancy ambivalence as a factor in early initiation. Our findings point to the need for additional research regarding barriers and facilitators of early prenatal care among women in Kentucky. A more holistic understanding of structural and systemic factors related to early prenatal care initiation can contribute to better outcomes for Kentucky's moms and babies.

CHAPTER FOUR: THE IMPACT OF THE COVID-19 PANDEMIC ON THE TIMING OF PRENATAL CARE INITIATION IN KENTUCKY: A REGRESSION DISCONTINUITY USING KENTUCKY PRAMS DATA (2017-2020)

4.0 Overview

OBJECTIVES: Prenatal care is one of the most frequently used healthcare services in the United States. The COVID-19 pandemic shifted healthcare delivery and interrupted access to care in communities across the United States. This study aimed to examine the magnitude of the impact of the COVID-19 pandemic on the timing of prenatal care initiation among a sample of women in Kentucky.

METHODS: This study used Phase 8 (2017-2020) Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS) data to assess the impact of the COVID-19 pandemic on the timing of prenatal care initiation in Kentucky using a quasi-experimental regression discontinuity design. Women who conceived between August 20, 2019, and March 26, 2020, received any prenatal care, gave birth in Kentucky, and responded to the PRAMS survey were included. We estimated coefficients for adjusted and unadjusted models and conducted robustness tests to establish the strength of the relationship between the start of the COVID-19 pandemic in Kentucky and the timing of prenatal care initiation.

RESULTS: The study sample included 464 women, consisting of 249 in the treatment group (pandemic-era) and 215 in the control group (pre-pandemic). The mean week of initiation differed for women in the control group (8.4 weeks gestation) compared to the treatment group (9.3 weeks gestation). We found that the COVID-19 pandemic caused an immediate and statistically significant 2-week delay in the timing of prenatal care initiation.

CONCLUSIONS: The COVID-19 pandemic negatively impacted the timing of prenatal care initiation among women in the study sample. Additional research is warranted to understand socioecological factors that contributed to or mitigated delays in prenatal care access in Kentucky.

KEYWORDS: Prenatal care, timing, PRAMS, Kentucky, regression discontinuity

4.1 Introduction

Early prenatal care is initiated in the first twelve weeks (often referred to as the first trimester) of pregnancy and is associated with improved maternal and neonatal outcomes (Barros et al., 1996; Nasiri et al., 2021). Initiating care early in pregnancy facilitates the establishment of the patient-provider relationship and provides opportunities to identify and address potential medical conditions that may result in adverse outcomes (The American College of Obstetricians and Gynecologists, 2017). Among women with pregnancy-related deaths between 2011 and 2013, 24.5% of decedents had initiated prenatal care in the second or third trimester and an additional 8.5% had not received any prenatal care (Howell, 2018). Recognizing its importance, Healthy People 2030 set a goal of increasing the proportion of pregnant women who receive early and adequate prenatal care from 75.6% (2021) to a target of 80.5% (U.S. Department of Health and Human Services, 2024).

In 2022, 21% of births in Kentucky were to women who received late or no prenatal care. In some counties, particularly those in rural areas of the state, receipt of late or no prenatal care was as high as 38.3% (March of Dimes Peristats, 2022). Kentucky is disproportionately impacted by maternity care deserts, or a county with no hospital or birth center offering obstetric care and no obstetric providers, compared to other states (March of Dimes, 2023b). In 2022, 45.8% of Kentucky counties were considered maternity care deserts, compared to 32.6% of counties in the United States (March of Dimes, 2023b). Additionally, Kentucky has the second highest maternal mortality rate in the United States at 39.7 deaths per 100,000 live births (2018-2020 average) (Hoyert, 2023). Late or no receipt of prenatal care has been cited by the Kentucky Maternal Mortality Review Committee as a factor associated with maternal deaths in the state (Kentucky Department for Public Health, 2022).

The COVID-19 pandemic catalyzed a significant shift in the delivery of care for many healthcare services, including routine prenatal care, and exacerbated systemic and inequitable barriers to access (Lee, 2023). To prevent the transmission of COVID-19 during pregnancy, many healthcare systems in the United States began shifting routine prenatal care from in-person to virtual/telehealth or hybrid visits (Boguslawski et al., 2022; Dotters-Katz & Hughes, 2020; Kern-Goldberger & Srinivas, 2022). Additionally, as places of employment and schools closed, women were challenged by additional barriers to early prenatal care initiation such as lack of access to childcare, increased financial strains and, in immigrant communities, heightened anxieties around deportation (Marshall et al., 2023).

There are limited studies that have assessed the impact of the COVID-19 pandemic on the timing of prenatal care initiation. In a study of women in South Carolina, Julceus and colleagues found that prenatal care initiation in the first three months of pregnancy was lower during the COVID-19 pandemic (25.0%) compared to prior to the pandemic (27.2%), with Black women experiencing the highest rates of late initiation during the pandemic (30.0%) (Julceus et al., 2023). Using National Natality File data from 2019-2020, Lee and Singh (2023) observed increases in delayed prenatal care initiation during the pandemic in non-Medicaid expansion states compared to Medicaid expansion states. Other studies have assessed the impact of telehealth on the timing of prenatal care initiation during the COVID-19 pandemic and found earlier initiation of prenatal care during the pandemic, compared to pre-pandemic (Boguslawski et al., 2022)

No study that we are aware of has estimated the magnitude of the impact of the COVID-19 pandemic on the timing of prenatal care initiation using a quasi-experimental regression discontinuity design. Further, no studies of the timing of prenatal care initiation have focused on Kentucky, a state that is disproportionately impacted by high maternal mortality rates and lack of access to maternity care (Hoyert, 2023; March of Dimes, 2023b). The aim of this study was to estimate the effect of the COVID-19 pandemic on the timing of prenatal care initiation in Kentucky using data from the Pregnancy Risk Assessment Monitoring Surveillance System (PRAMS). We hypothesized that the timing of prenatal care initiation was significantly and negatively impacted by the COVID-19 pandemic.

4.2 Methods

Data Source

The data source for this analysis was Phase 8 (2017-2020) Kentucky Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS is a state-level, population-based surveillance effort conducted in partnership between the Centers for Disease Control and Prevention (CDC) and state health departments. PRAMS collects data about maternal behaviors and experiences at and around the time of pregnancy using mixed modes (telephone and mail) (Shulman et al., 2018). Kentucky began collecting PRAMS survey data in 2017 and currently has data available through 2020 (Kentucky Department for Public Health, 2018). The 2021 Kentucky PRAMS data is not available for research use due to a low response rate (45.5%) that did not meet the 50% threshold required by the CDC (Centers for Disease Control and Prevention, 2023a).

PRAMS uses a stratified random sampling methodology and draws from the state's birth certificate records. The sample consists of women who have had a live birth in the previous two to six months. PRAMS survey responses are linked to the state's birth certificate records, making PRAMS a rich source of data to understand maternal experiences and outcomes (Shulman et al., 2018). Deidentified PRAMS data was obtained from the Kentucky Department for Public Health. This study was approved by the Institutional Review Boards at the Kentucky Cabinet for Health and Family Services and the University of Louisville.

Socioecological Model

The Socioecological Model (SEM) was applied to systematically select independent variables available in the PRAMS dataset and identify recommendations for future research. The SEM domains include intrapersonal (individual-level), interpersonal (relational), and environmental (contextual and systemic) factors (Stokols, 1996). The SEM acknowledges the dynamic interdependence of intrapersonal, interpersonal, and environmental factors on access to care and health outcomes (McLeroy et al., 1988; Stokols, 1996). The focus of this analysis was the impact of the COVID-19 pandemic, which is a factor in the environmental domain.

Dependent Variable

The dependent variable for this study was the week of pregnancy when prenatal care was initiated, derived from the PRAMS question, "How many weeks or months pregnant were you when you went for your first prenatal care visit?" This variable is continuous and ranges from 1-40. This information was self-reported by the PRAMS survey respondent.

Independent Variable of Interest

The focus of this analysis was the COVID-19 pandemic, which is a factor in the environmental domain of the SEM. On March 6, 2020, the governor of Kentucky signed an Executive Order declaring the COVID-19 pandemic a state of emergency (Commonwealth of Kentucky, 2020). This analysis assumed that the start of the pandemic in Kentucky was March 6, 2020, and similarly assumed that this was the date when disruptions in prenatal care services began.

Independent Variables

Independent variables were selected based on their availability in the PRAMS data and were informed by current literature about the timing of prenatal care initiation (Harvey et al., 2021; Julceus et al., 2023; Sebens & Williams, 2022). The selected variables were categorized according to the SEM framework (Table *7*).

Table 7. Independent Variables by SEM Domain

Intrapersonal	**Interpersonal**	**Environmental**
Prenatal Care Health Insurance Maternal Education Pregnancy Intention Maternal Age Maternal Race Previous Live Births Household Income	Marital Status	Maternal Residence WIC

Study Design

This study used a regression discontinuity (RD) design to estimate the effect of the COVID-19 pandemic on the timing of prenatal care initiation in Kentucky. Regression discontinuity is a quasi-experimental method that exploits a naturally occurring event to, effectively, randomize individuals into treatment and control groups (Lee & Lemieux, 2010). In this study, we exploit the COVID-19 pandemic as a natural experiment to evaluate its impact on the timing of prenatal care initiation. The RD methodology is optimal for a basic pre-post comparison of the impact of the COVID-19 pandemic because of its ability to potentially eliminate the effect of selection bias.

Regression discontinuity requires a continuous dependent variable and a continuous independent variable on which a discontinuity on the dependent variable can be observed. The corresponding point on the independent variable, which is also called the running variable, provides a cutoff that can be used to assign the individuals in the sample to treatment and control groups. In this study, the running variable was the assumed week of conception, calculated by subtracting 270 days, the length of a full-term pregnancy, from the infant's birthdate, which was available through linked birth certificate records. This analysis focused on conception dates between August 20, 2019, and March 26, 2020, the last date of assumed conception for which data is available in the Kentucky PRAMS dataset. The start date of the COVID-19 pandemic was designated as March 6, 2020, the date on which an Executive Order was issued declaring a state of emergency for COVID-19 in Kentucky (Commonwealth of Kentucky, 2020).

The primary (local linear) specification used the following equation:

$$Y_i = \alpha + f(\gamma;\ conception) + \beta COVID + \delta X_i + \varepsilon_i$$

where i indicated a pregnant woman, Y was the week gestation when prenatal care was initiated, $conception$ was the running variable, $f(\gamma;\ conception)$ was a flexible function that captured trends in the timing of prenatal care initiation before and after the start of the COVID-19 pandemic, and X included the set of independent variables as defined in Table *7*. The variable $COVID$ was a binary variable that was equal to 1 if the first trimester of pregnancy overlapped with the COVID-19 pandemic; 0 otherwise. The coefficient of $COVID$, β, measured the effect of exposure to the COVID-19 pandemic on the timing of prenatal care initiation.

We defined the first trimester as up to 12 weeks gestation. Using this definition, the earliest conception week of 2019 in which first-trimester prenatal care initiation would have been impacted by the start of the pandemic is December 10, 2019 (week 50 of 2019). This date was assigned as the cutoff, or discontinuity, for the analysis. Because data was available for conception dates through March 26, 2020 (week 13 of 2020), we extended the treatment group to include all data available in the existing PRAMS dataset. This construction of the treatment group extended a total of 16 weeks (week 50 of 2019 to week 13 of 2020). To create an equivalent control group, we included 16 weeks prior to the cutoff date (week 34 of 2019). This method was used to establish the bandwidth for the primary analyses.

Using linear and quadratic functional forms for the trends structure, we estimated the effects of the COVID-19 pandemic on the timing of prenatal care initiation in the study sample. If the assumptions of regression discontinuity are met, then the cutoff effectively assigns individuals into treatment and control groups, similar to a randomized controlled trial and the RD can estimate a causal impact (Lee & Lemieux, 2010; Oldenburg et al., 2016).

We conducted several sensitivity analyses and robustness checks to ensure the assumptions of RD were met. First, we examined the key assumption of RD design that baseline characteristics for the treatment and control groups were similar, indicating effective randomization by the treatment variable. We calculated the distribution of response for the treatment and control group for each of the independent variables and conducted chi-square tests to assess for differences between the groups.

A second and third assumption of RD is that the distribution of independent variables around the cutoff is smooth, demonstrating no discontinuity that could be correlated with the running variable (assumed week of conception), and that the running variable shows no sign of manipulation at the cutoff. We tested for smoothness around the cutoff for two independent variables, prenatal care health insurance and maternal education, selected because of their strong association with early prenatal care initiation as reported in Chapter 3. Because these are categorical variables, we calculated the percentage of respondents in each category of the variable by week and assessed the distribution around the cutoff. We additionally used the McCrary Test to assess the density of the running variable for manipulation at the cutoff (McCrary, 2008).

A fourth assumption of RD is that the regression estimates are robust to other bandwidths around the cutoff. We tested for this assumption by using the data-driven bandwidth option selected by the “rdrobust” package in Stata 17 and compared these results to the estimates obtained in the primary analysis.

A fifth assumption is that the point estimates of the analysis are not sensitive to the inclusion of independent variables in the model. We checked these assumptions by running adjusted and unadjusted estimates for the regression discontinuity analysis and reported the results separately.

In addition, we conducted a set of placebo tests in which we used the same bandwidth and cutoff points as in the primary specification to estimate an effect for the 2016-2017, 2017-2018, and 2018-2019 periods, assuming that the pandemic took place in the previous years and a state of emergency was announced on March 6 in those years as well. We expected that no effects would be detected under the hypothetical scenarios.

All analyses were conducted in Stata 17 using the “rdrobust” package. The threshold p-value for statistical significance was less than 0.05.

4.3 Results

A total of 464 women had an assumed conception date in the study period (week 34 of 2019 through week 13 of 2020), responded to the PRAMS survey, and were included in the primary analysis sample. There were 249 women in the control group (pre-pandemic, weeks 34-49 of 2019), and the mean week of prenatal care initiation among that group was 8.4 weeks gestation. There were 215 women in the treatment group (pandemic-exposed, week 50 of 2019 through week 13 of 2020) with the mean week of prenatal care initiation being 9.3 weeks gestation. There were no statistically significant differences across the independent variables when comparing the treatment and control groups with the exception of prenatal care health insurance (p=0.05). This difference likely reflected the significant number of missing values, relative to the overall sample size, for this variable rather than a difference in the characteristics of the control and treatment groups. No differences were observed in maternal education, maternal residence, pregnancy intention, marital status, maternal age, maternal race, household income, previous live births, or WIC. Table *8* provides summary statistics on independent variables for the control (pre-pandemic) and treatment (pandemic-exposed) groups and validates the assumption that the groups were comparable.

Table 8. Characteristics of Treatment and Control Groups at the Cutoff (Week 50), 2019-2020

	Control Weeks 34-49 of 2019	Treatment Weeks 50-52 of 2019 Weeks 1-13 of 2020	p-value
N	249	215	
Week of initiation (mean)	8.4	9.3	
Standard Deviation	4.3	4.6	
Prenatal Care Health Insurance, n (%)			
None	3 (1.2)	6 (2.8)	0.05
Private or Employer-Based	94 (37.8)	76 (35.6)	
Public	141 (56.6)	111 (51.6)	
Missing	11 (4.4)	22 (10.2)	
Maternal Education, n (%)			
Less than High School	29 (11.7)	26 (12.1)	0.818
High School	81 (32.5)	63 (29.3)	
Some College	80 (32.1)	71 (33.0)	
College Graduate or Higher	58 (23.3)	55 (25.6)	
Missing	1 (0.4)	0 (0.0)	
Maternal Residence, n (%)			
Urban	183 (73.5)	152 (70.7)	0.503
Rural	66 (26.5)	63 (29.3)	
Missing	0 (0.0)	0 (0.0)	
Pregnancy Intention, n (%)			
Wanted to be Pregnant Later	58 (23.3)	46 (21.4)	0.467

	Control Weeks 34-49 of 2019	Treatment Weeks 50-52 of 2019 Weeks 1-13 of 2020	p-value
Wanted to be Pregnant Sooner	24 (9.6)	25 (11.6)	
Wanted to be Pregnant Then	98 (39.4)	74 (34.4)	
Did Not Want Then or Anytime	26 (10.4)	19 (8.8)	
Unsure of What I Wanted	41 (16.5)	50 (23.3)	
Missing	2 (0.8)	1 (0.5)	
Marital Status, n (%)			
Married	110 (44.2)	100 (46.5)	0.614
Not Married	139 (55.8)	115 (53.5)	
Missing	0 (0.0)	0 (0.0)	
Maternal Age, n (%)			
Less than 20 years	17 (6.8)	9 (4.2)	0.488
20-24 years	68 (27.3)	49 (22.8)	
25-29 years	76 (30.5)	69 (32.1)	
30-34 years	55 (22.1)	56 (26.1)	
35 years and older	33 (13.3)	32 (14.9)	
Missing	0 (0.0)	0 (0.0)	
Maternal Race, n (%)			
White	114 (45.8)	92 (42.8)	0.348
Black	109 (43.8)	91 (42.3)	
Other	26 (10.4)	32 (14.9)	
Missing	0 (0.0)	0 (0.0)	
Household Income, n (%)			
Poor	76 (30.5)	69 (32.1)	0.971
Low Income	69 (27.7)	59 (27.4)	
Middle/High Income	88 (35.3)	75 (34.9)	
Missing	16 (6.4)	12 (5.6)	
Previous Live Births, n (%)			
None	101 (40.6)	76 (35.4)	0.481
One	82 (32.9)	74 (34.4)	
Two or More	66 (26.5)	65 (30.2)	
Missing	0 (0.0)	0 (0.0)	
WIC, n (%)			
Yes	112 (45.0)	96 (44.7)	0.943
No	137 (55.0)	119 (55.3)	
Missing	0 (0.0)	0 (0.0)	

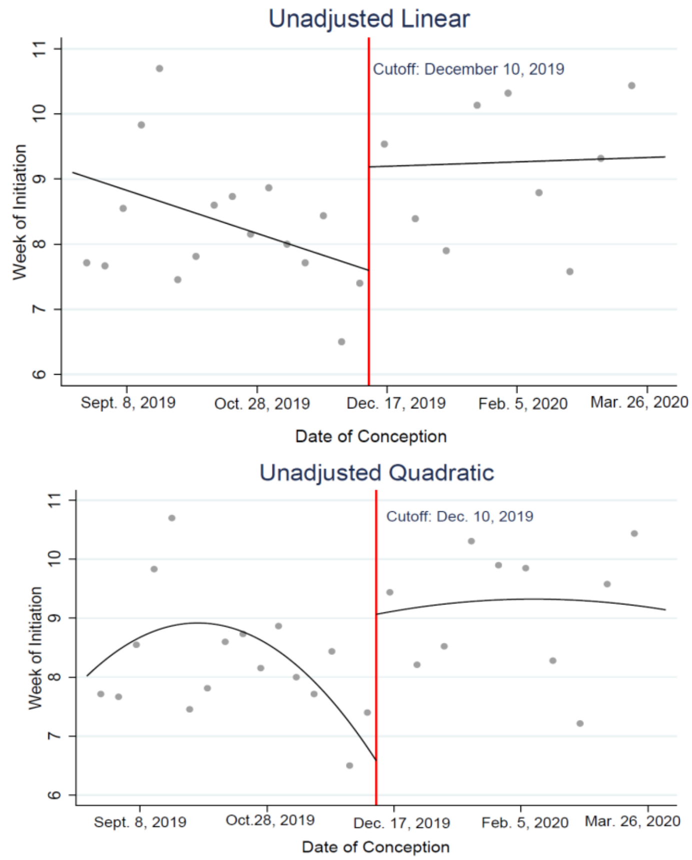
The period of interest, 2019-2020, showed a two-week delay in the timing of prenatal care initiation in the linear unadjusted (β=2.1561, $p<0.05$) and linear adjusted models (β=1.828, $p<0.05$), both of which were statistically significant at the 0.05 level. The quadratic unadjusted (β=2.5216, $p<0.10$) model showed a 2.5-week delay. The quadratic adjusted (β=1.5828, p=0.134) model showed a 1.5-week delay. Additionally, as expected, estimates were robust to the inclusion of independent variables. The linear (β=1.828, $p<0.05$) and quadratic (β=1.5828, p=0.134) adjusted models showed an approximately two-week delay in the timing of prenatal care initiation. Table *9* presents the coefficients and robust standard errors of the effect of the COVID-19 pandemic on the timing of prenatal care initiation by year for the adjusted and unadjusted models with linear and quadratic fits as well as estimates for placebo tests for 2016-2017, 2017-2018, 2018-2019. We observed no effects on the timing of prenatal care initiation in the placebo years, as expected. Figure 4 is a visual representation of the unadjusted estimates using the linear and quadratic models at the cutoff point, December 10, 2019, for 2019-2020.

Table 9. Effects of COVID-19 on Prenatal Care Timing, Adjusted and Unadjusted Linear and Quadratic Models

	Unadjusted		Adjusted	
	Linear	Quadratic	Linear	Quadratic
2019-2020	2.1561**	2.5216*	1.828**	1.5828
	(0.99573)	(1.30290)	(0.83315)	(1.0552)
2018-2019	0.51424	-0.29878	0.52019	-0.00944
	(1.23150)	(1.66350)	(1.10250)	(1.49010)
2017-2018	-2.2303	-1.3256	-1.8646	-0.85904
	(0.99581)	(1.25370)	(0.90681)	(1.16750)
2016-2017	0.62246	0.59111	0.43217	0.28747
	(2.0744)	(2.79070)	(1.85730)	(2.47410)

*p<0.1, **p<0.05, ***p<0.01
Robust standard errors in parentheses

Figure 4. Unadjusted Estimates of the Impact of the COVID-19 Pandemic on Prenatal Care Timing



Appendix Figure 1 and Appendix Figure 2 display the results of the smoothness test for two independent variables, prenatal care health insurance, and maternal education. Because both variables were categorical, we assessed for balance by calculating their percentage distribution by week within the bandwidth. We observed a balanced distribution of the variables within all categories around the cutoff point. Similarly, a density plot of the running variable, assumed week of conception, showed no discontinuities at the cutoff point (Appendix Figure 3), which was further confirmed by an insignificant value for the McCrary Test (p=0.3272). Appendix Table *19* displays the results of the point estimates of the impact of the COVID-19 pandemic on the timing of prenatal care initiation using the optimal bandwidth generated by the "rdrobust" function in Stata. Using the optimal bandwidth, which was narrower than the manually selected bandwidth used in the primary analysis, the estimated effect of the pandemic on the timing of prenatal care initiation for the unadjusted linear and quadratic models was 3.3462 weeks ($p<0.10$) and 3.5431 weeks ($p<0.10$), respectively (Appendix Table *19*). A larger effect was expected within the narrower bandwidth because it included the period immediately preceding the start of the COVID-19 pandemic whereas the larger bandwidth included a longer time period prior to the start of the pandemic. Results from the placebo tests (2016-2017, 2017-2018, and 2018-2019) using the optimal bandwidth can be found in Appendix Table *19*. No statistically significant effects were observed in the placebo tests, as expected.

Overall, we concluded that the estimates obtained in the main (unadjusted linear) specification were robust and pointed to an immediate two-week delay in the timing of prenatal care initiation among women in the study sample.

4.4 Discussion

Using Phase 8 Kentucky PRAMS data from 2017 to 2020, we found that the COVID-19 pandemic was associated with a two-week delay in the timing of prenatal care initiation among women in the sample whose first trimester of pregnancy overlapped with the start of the COVID-19 pandemic. This analysis provided evidence of the direct and immediate impact of the COVID-19 pandemic on the timing of prenatal care initiation among women in Kentucky. This study contributes to the existing literature by estimating the effect of the COVID-19 pandemic on the timing of prenatal care initiation by using a quasi-experimental design, which reduces the likelihood of selection bias. Existing studies of prenatal care timing and the COVID-19 pandemic have focused on cross-sectional designs, and results may have been impacted by selection bias. This study also contributes to existing literature by adding findings specific to Kentucky, a state that has high rates of maternal mortality and a disproportionate percentage of maternity care deserts, relative to the United States (Centers for Disease Control and Prevention, 2023b; March of Dimes, 2023a).

In 2023, a National Vital Statistics Report documented that timing of prenatal care initiation in the United States increased by 0.2% from 2019 to 2020 while the percentage of women beginning care within the first four months of pregnancy with fewer than the recommended number of prenatal care visits increased by 22% during the same time period, attributing changes in prenatal care due to the pandemic to frequency of visits as opposed to timing of initiation (Martin & Osterman, 2023). Conversely, cross-sectional analyses have observed differences in the timing of prenatal care initiation before and after the COVID-19 pandemic. In a study of more than 450,000 births that occurred between January 2018 and December 2021 in Ontario, Canada, Hetherington and colleagues observed a noticeable but brief disruption in first-trimester prenatal care initiation around the start of the pandemic (Hetherington et al., 2024). Using 2019-2020 National Natality Files, Lee and Singh (2023) reported decreased and delayed prenatal care utilization among women in non-Medicaid expansion states during the COVID-19 pandemic. They observed that the odds of having no prenatal care decreased by 4%

during the pandemic in expansion states but increased by 13% in non-expansion states (Lee & Singh, 2023).

Delays in the timing of prenatal care initiation have not been equitable across intrapersonal or environmental domains of the SEM. A national-level study using PRAMS data from October 2020 through June 2021 reported delays in the receipt of prenatal care during the pandemic, including significant and long-term disruptions that disproportionately impacted Hispanic women, those with less education, women with Medicaid coverage, and those who had a previous live birth (Lee, 2023). Reported barriers varied by sociodemographic characteristics with Hispanic women reporting delays or cancellations due to facility closures, lack of transportation, loss of insurance, and reasons related to COVID-19 while Black women reported being more impacted by barriers related to insurance and lack of transportation (Lee, 2023).

The use of telehealth appears to have mitigated the effects of the pandemic in some contexts and for some sub-populations. Boguslawski and colleagues found that, in a public hospital in Atlanta, the rapid implementation of telehealth for prenatal care visits contributed to a significant improvement in first-trimester prenatal care initiation in the pandemic-exposed cohort compared to the pre-pandemic cohort (46.1% vs. 39.0%). Among Hispanic women, however, the study reported a 33% decline in the proportion of women who initiated care during the pandemic (Boguslawski et al., 2022). Duryea and colleagues found that implementation of an audio-only virtual prenatal care visit system during the pandemic in Dallas, Texas was associated with women presenting earlier for prenatal care in 2020, compared to 2019 (11 weeks gestation vs. 12 weeks gestation).

They additionally found that women in 2020 attended a greater mean number of prenatal care visits compared to women in 2019 (9.8 vs. 9.4) (Duryea et al., 2021). A recent mixed methods study found that reasons for not using telehealth services for routine prenatal care during the pandemic included lack of access to telehealth as an option for care, uncertainty about the quality of care, and concerns about developing a trusting patient-provider relationship (Wu et al., 2024).

This study provides further evidence of the systemic impact of the COVID-19 pandemic on the timing of prenatal care initiation in Kentucky. Future research can supplement this study's findings by further exploring the differential impact of the pandemic by stratifying analyses by intrapersonal domain factors of the SEM, including maternal race and insurance type.

Limitations

There are limitations in this study that must be considered. First, the measure of the timing of prenatal care initiation used in this study was self-reported by PRAMS respondents and may be subject to recall bias. An additional limitation of this study is the small sample size used for the analysis, which is a limitation of the Kentucky PRAMS dataset due to high rates of non-response. Ideally, regression discontinuity uses a large sample size to obtain precise results. Additionally, while regression discontinuity designs have strong internal validity, they estimate a local treatment effect that may lack external validity. We note that the stratified random sampling design of the PRAMS survey ensures the analysis is relevant to the general population of women in Kentucky. The Kentucky PRAMS dataset does not extend to those with conception dates later than

March 26, 2020, limiting the ability to assess the less immediate disruptions to prenatal care initiation that may have been caused by the extended period of the COVID-19 pandemic. Nevertheless, this analysis demonstrated that the start of the COVID-19 pandemic had an immediate and significant impact on access to prenatal care.

4.5 Considerations for Future Research

This study assessed the impact of the start of the COVID-19 pandemic on the timing of prenatal care initiation among women who conceived within the 32 weeks surrounding the start of the COVID-19 pandemic, gave birth in Kentucky, and responded to the Kentucky PRAMS survey. Future analyses should estimate the impact of the pandemic on prenatal care timing among sub-populations of women who face additional barriers to prenatal care. While this analysis provided evidence that the COVID-19 pandemic was associated with delayed initiation of prenatal care, it does not provide information about contextual factors such as emotional and physical factors that may have negatively or positively impacted prenatal care during the time of the pandemic. One additional avenue for future research concerns the interpersonal domain of the SEM and the finding of a recent study that non-use of telehealth during the COVID-19 pandemic was associated with concern about the establishment of a trusting patient-provider relationship (Wu et al., 2024). Future analyses may use qualitative or mixed methods studies to provide depth and robustness to the unique barriers to care presented during the pandemic. A deeper exploration of these factors could contribute to the development of strategies to mitigate the long-term effects of the pandemic and other public health emergencies on prenatal care initiation. Future analyses regarding community- or hospital-level strategies that were implemented in Kentucky to increase access to prenatal care during the pandemic, such as telehealth visits, should be evaluated to assess their effectiveness in the long and short-terms. Finally, future research should use larger datasets to investigate the longer-term impacts of the pandemic on the timing of prenatal care initiation and birth outcomes, particularly among women whose care was delayed or negatively impacted by the pandemic.

4.6 Conclusion

The COVID-19 pandemic created a seismic shift in the delivery of healthcare services, including routine prenatal care, and contributed to and exacerbated barriers to prenatal care initiation. This study provided evidence of an immediate two-week delay in the timing of prenatal care initiation among women who conceived in the three months leading up to the pandemic. This study provides the foundation for research on the identification of specific barriers to initiation of prenatal care in times of public health crisis and upheaval. Further investigation can support the development of targeted strategies to mitigate the long-term effects of the COVID-19 pandemic on the timing of prenatal care initiation.

CHAPTER FIVE: CONCLUSION

5.0 Summary

This dissertation examined barriers and facilitators associated with the timing of prenatal care initiation in the United States and Kentucky using the Socioecological Model as a guiding framework. Together, the three papers of this dissertation present a holistic multi-level approach for examining and understanding intrapersonal, interpersonal, and environmental factors that contribute to the timing of prenatal care initiation.

There is evidence that early prenatal care, initiated in the first trimester of pregnancy, is beneficial for maternal and neonatal outcomes (Howell, 2018; Partridge et al., 2012). Additionally, reviews of maternal deaths in Kentucky, and other communities, have found negative associations between receipt of prenatal care and maternal mortality (Kentucky Department for Public Health, 2022; Philadelphia Maternal Mortality Review Committee, 2022). Significant disparities in the timing of prenatal care initiation persist (Martin & Osterman, 2023). Contributing factors to disparities in first-trimester prenatal care initiation are driven by differences in intrapersonal, interpersonal, and environmental factors that influence differential access to, and utilization of, prenatal care.

The first paper of this dissertation, a scoping review, provided an overview of barriers and facilitators of first-trimester prenatal care in the United States since the implementation of the Affordable Care Act. Barriers and facilitators, and research and practice recommendations, were categorized using the Socioecological Model to identify gaps and opportunities to understand and address the timing of prenatal care initiation more holistically. All articles included in the scoping review used a measure of prenatal care timing. A key finding of the scoping review was the lack of consistency in the definition of “first trimester” across studies, which may limit the ability to compare outcomes across studies. A second finding of the scoping review was that, while there have been improvements in the timing of prenatal care initiation, these improvements have not been equitable. Undocumented immigrants, for example, experience unique barriers to prenatal care initiation such as lack of access to appropriate interpretation services, the negative impacts of anti-immigration rhetoric and policies, and lack of or no access to prenatal care health insurance. These challenges contribute to later initiation of prenatal care among immigrants compared to non-immigrant women. Additionally, while most articles included in the review stratified results by race for closer examination of racial disparities in the timing of care, only two articles assessed the timing of prenatal care initiation among American Indian/Alaska Native women, pointing to a gap in the literature. Additionally, several research, practice, and policy recommendations were extracted from the literature and categorized using the SEM. Given that most of the articles included in the scoping review assessed the impact of environmental factors, it was found that most of the recommendations were also in this domain of the SEM, contributing to gaps in understanding the relationship between prenatal care timing and interpersonal factors, in particular.

The second paper of this dissertation assessed factors associated with early prenatal care initiation among women in Kentucky using PRAMS data from 2017 to 2020. This study used linear and logistic regression to identify the most significant factors associated with receiving early or late prenatal care. One aim of this study was to begin building the foundation for better understanding who is—and who is not—receiving early prenatal care in Kentucky. Using PRAMS data and excluding women who gave birth after the start of the COVID-19 pandemic in March 2020, we found that the most significant factors associated with early prenatal care were no health insurance, pregnancy ambivalence, less than a high school education, and urban residence. This study confirmed much of what is already known about intrapersonal factors associated with early prenatal care initiation but surfaced an unanticipated finding that urban residence was negatively and significantly associated with early prenatal care initiation. This finding warrants additional exploration. Prior research has identified that prenatal care timing may be more associated with distance traveled to care rather than rural/urban residence (Kennedy et al., 2022). Future research that assesses distance traveled to prenatal care or environmental and neighborhood factors may provide more insight into the relationship between residence and the timing of prenatal care initiation. Overall, paper two provided a valuable perspective regarding potential leverage points for future research and practice recommendations related to the timing of prenatal care initiation among women in Kentucky.

The third paper of this dissertation assessed the impact of the COVID-19 pandemic, a factor in the environmental domain of the SEM, on the timing of prenatal care initiation among women in Kentucky. Using PRAMS data and a quasi-experimental regression discontinuity design, we found an immediate and statistically significant 2-week delay in the initiation of prenatal care around the start of the COVID-19 pandemic, among women whose assumed conception was in the three months preceding the start of the pandemic. The estimates obtained in the analysis were tested for robustness using a variety of methods, including conducting placebo tests for 2016-2017, 2017-2018, and 2018-2019, running adjusted and unadjusted models using the same covariates that were used in the second dissertation paper, and by using the optimal bandwidth generated by the “rdrobust" package in Stata 17. The estimates of the regression discontinuity were robust to each of these tests, providing evidence of the systemic impact of the pandemic on the timing of prenatal care initiation in Kentucky. While this analysis suggests the immediate impact of COVID-19 on the timing of prenatal care initiation, it does not provide insights into the sociodemographic characteristics of those who may have been impacted nor does it provide information regarding mid-or long-term delays in care initiation.

The three papers in this dissertation provide insights into the socioecological factors associated with the timing of prenatal care initiation among women in the United States and Kentucky, a state that is disproportionately impacted by adverse birth outcomes. Together, these findings provide a strong foundation for future research and policy agendas that can improve outcomes for mothers and infants.

5.1 Implications for Future Research

The use of the SEM as a guiding framework for this dissertation provided an opportunity to systematically identify gaps and opportunities for future research. One gap identified in paper one of this dissertation was the lack of mixed-methods research that used a measure of first-trimester prenatal care to assess the timing of initiation. Additional mixed-methods studies can contribute to an improved understanding of the contextual factors related to the timing of prenatal care initiation, which is especially important in sub-populations of women who may experience unique challenges.

While the Kentucky PRAMS dataset provides rich data for understanding maternal experiences and outcomes around the time of pregnancy, it also presented limitations. Due to low response rates, the PRAMS data had a small sample size, which presented statistical challenges in papers two and three when analyses were stratified by prenatal care timing (paper two) and when the sample was narrowed because of the bandwidth used in the regression discontinuity (paper three). In addition, the Kentucky PRAMS data did not extend beyond March 2020, which limited the ability to assess the longer-term impacts of the COVID-19 pandemic on the timing of prenatal care initiation. The national PRAMS data, with its larger sample size and more recent data, may be used in future studies to more comprehensively assess factors associated with the timing of prenatal care initiation. Additionally, in relation to the PRAMS dataset, Kentucky may consider adding questions to the PRAMS survey that capture information regarding barriers to prenatal care and satisfaction with the timing of prenatal care. These questions are options provided to states by the CDC but are not currently included in the Kentucky PRAMS data.

Future research that centers women and elevates their voices is needed to better understand the lived experience of women as it relates to the timing of prenatal care initiation. A future research agenda should include an assessment of short- and long-term maternal and infant outcomes. Additionally, place-based research can provide insight into effective practice and policy recommendations, and opportunities for community engagement, that can catalyze effective change to improve the lives of women and infants.

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APPENDICES

Appendix Table 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	11
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	11-12
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	13
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	14
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	15
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	15-16
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	15-16
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix Table 2
Selection of sources of evidence	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	16

Data charting process	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	16
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	N/A
Critical appraisal of individual sources of evidence	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	16
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	17
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	18-20
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	26-40
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	41-44
Limitations	20	Discuss the limitations of the scoping review process.	45
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	46
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	N/A

Appendix Table 2. Search Strings by Database

Term	Search Strings/Database					
	Social Science Abstracts (AB)	CINAHL (AB)	Cochrane (TI/AB)	Embase	PubMed	MeSH
Prenatal Care	prenatal care OR pre-natal care	prenatal care OR pre-natal care	prenatal care OR pre-natal care	'prenatal care':ab,ti OR 'pre-natal care':ab,ti	"prenatal care"[Title/Abstract] OR "pre-natal care"[Title/Abstract]	"Prenatal Care"[MeSH Terms]
Prenatal Care Utilization	prenatal care utilization OR pre-natal care utilization OR timing N5 prenatal OR time factors	prenatal care utilization OR pre-natal care utilization OR timing N5 prenatal OR time factors	prenatal care utilization OR pre-natal care utilization OR time factors	'prenatal care utilization':ab,ti OR 'pre-natal care utilization':ab,ti OR 'timing':ab,ti	prenatal care utilization"[Title/Abstract] OR pre-natal care utilization"[Title/Abstract] OR "timing prenatal"[Title/Abstract :~5]	"Time Factors"[MeSH Terms]
Social Determinants of Health	social determinants of health OR determinants of health OR sdoh OR factor* OR impact	social determinants of health OR determinants of health OR sdoh OR factor* OR impact	social determinants of health OR determinants of health OR sdoh OR factor* OR impact	'social determinants of health':ab,ti OR 'determinants of health':ab,ti OR factor*:ab,ti OR impact:ab,ti	"social determinants"[Title/Abstract] OR "factor*"[Title/Abstract] OR "impact"[Title/Abstract]	"Health Services Accessibility"[MeSH Terms] OR "Social Determinants of Health"[MeSH Terms]

Appendix Table 3. STROBE Statement

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	47
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	47-48
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	49-51
Objectives	3	State specific objectives, including any prespecified hypotheses	51
Methods			
Study design	4	Present key elements of study design early in the paper	51-52
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	53
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	53
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	53-58
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	53-58
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	Figure 3
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	53-58
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	58-59
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	59
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	59
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed	Figure 3
		(b) Give reasons for non-participation at each stage	Figure 3
		(c) Consider use of a flow diagram	Figure 3
Descriptive data	14*	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Table 5, 63-64

		(b) Indicate number of participants with missing data for each variable of interest	Figure 3
Outcome data	15*	Report numbers of outcome events or summary measures	63-65
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Appendix 2, Tables 4-18
		(*b*) Report category boundaries when continuous variables were categorized	53
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarize key results with reference to study objectives	67-68
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	73
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	67-73
Generalizability	21	Discuss the generalizability (external validity) of the study results	73
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

Appendix Table 4. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal Race and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal Race (Ref: White)															
Black	0.640***	0.637***	0.554**	0.315	0.516**	0.577**	0.648***	0.502**	0.339	0.640***	0.669***	0.648***	0.676***	0.339	0.669***
	(0.225)	(0.228)	(0.233)	(0.268)	(0.238)	(0.228)	(0.234)	(0.243)	(0.250)	(0.225)	(0.224)	(0.225)	(0.228)	(0.238)	(0.223)
Other	0.283	0.293	-0.146	0.175	0.191	0.266	0.286	-0.174	0.112	0.283	0.260	0.294	0.257	0.211	0.344
	(0.641)	(0.645)	(0.637)	(0.654)	(0.634)	(0.644)	(0.644)	(0.660)	(0.654)	(0.641)	(0.641)	(0.639)	(0.630)	(0.630)	(0.638)
Maternal Age (Ref: 25-29)															
<20 Years		0.952*													
		(0.496)													
20-24 Years		0.0324													
		(0.333)													
30-34 Years		0.256													
		(0.328)													
>=35 Years		-0.0465													
		(0.340)													
Maternal education (Ref: College or higher)															
Less than High School			2.945***												
			(0.653)												
High School Graduate			0.425												
			(0.276)												
Some College			-0.114												
			(0.197)												
Marital Status (Ref: Not Married)				-0.822***											
				(0.276)											
Maternal Residence (Ref: Urban)					-0.365										
					(0.246)										
Previous Live Births (Ref: None)															
One						-0.334									
						(0.259)									

Two or More	0.876***							
	(0.314)							
WIC (Ref: No)		-0.0454						
		(0.252)						
Household Income (Ref: Middle/High Income)								
Poor			1.314***					
			(0.302)					
Near Poor			1.282**					
			(0.555)					
Low Income			0.518					
			(0.345)					
Pre-pregnancy Diabetes (Ref: No)				-0.000659				
				(0.615)				
Pre-pregnancy Hypertension (Ref: No)					-0.625*			
					(0.350)			
Pre-pregnancy Depression (Ref: No)						0.236		
						(0.310)		
Maternal BMI (Ref: Normal)								
Underweight							0.282	
							(0.596)	
Overweight							0.211	
							(0.329)	
Obese							-0.372	
							(0.266)	
Pregnancy Intention (Ref: Wanted to be pregnant then)								
Wanted to be pregnant later								0.838**
								(0.334)
Wanted to be pregnant sooner								-0.0785
								(0.313)
Didn't want to be pregnant then or anytime								1.643***

														(0.497)	
I wasn't sure what I wanted														1.021***	
														(0.391)	
Maternal Smoking (Ref: No)															0.590
															(0.410)
Constant	8.258***	8.126***	7.836***	8.789***	8.791***	8.104***	8.276***	7.758***	7.695***	8.258***	8.299***	8.212***	8.325***	7.838***	8.163***
	(0.132)	(0.188)	(0.171)	(0.254)	(0.376)	(0.184)	(0.149)	(0.127)	(0.129)	(0.133)	(0.137)	(0.140)	(0.181)	(0.180)	(0.131)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.003	0.006	0.058	0.011	0.004	0.016	0.003	0.038	0.021	0.003	0.004	0.003	0.003	0.020	0.005

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Summary: Maternal race is a strong predictor of prenatal care timing. Marital status, household income, and pregnancy intention are rather strongly correlated with maternal race, as they pick up about 50% of size of the coefficients of maternal race. Maternal education, maternal residence, previous live births, and prenatal insurance have a modest correlation with maternal race, as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal race because their inclusion has no effect on the bivariate coefficient.

Appendix Table 5. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal Education and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal education (Ref: College or higher)															
Less than High School	2.922***	2.945***	2.980***	2.833***	2.985***	2.815***	3.038***	2.430***	2.736***	2.935***	2.888***	2.926***	2.875***	2.816***	2.916***
	(0.637)	(0.653)	(0.657)	(0.640)	(0.635)	(0.636)	(0.637)	(0.639)	(0.680)	(0.637)	(0.637)	(0.636)	(0.636)	(0.651)	(0.640)
High School Graduate	0.417	0.425	0.489	0.354	0.461	0.412	0.545*	0.330	0.282	0.425	0.395	0.415	0.421	0.411	0.413
	(0.280)	(0.276)	(0.301)	(0.287)	(0.282)	(0.276)	(0.301)	(0.281)	(0.294)	(0.283)	(0.281)	(0.281)	(0.279)	(0.274)	(0.280)
Some College	-0.160	-0.114	-0.300	-0.0111	-0.288	-0.0739	-0.382*	-0.0391	0.140	-0.152	-0.185	-0.143	-0.208	-0.00243	-0.151
	(0.193)	(0.197)	(0.223)	(0.217)	(0.197)	(0.191)	(0.225)	(0.222)	(0.222)	(0.195)	(0.195)	(0.197)	(0.197)	(0.193)	(0.200)
Maternal Age (Ref: 25-29)															
<20 Years			-0.110												
			(0.559)												
20-24 Years			-0.304												
			(0.341)												
30-34 Years			0.394												
			(0.323)												
>=35 Years			-0.204												
			(0.319)												
Maternal Race (Ref: White)															
Black		0.554**													
		(0.233)													
Other		-0.146													
		(0.637)													
Marital Status (Ref: Not Married)				-0.419											
				(0.287)											
Maternal Residence (Ref: Urban)					-0.701***										
					(0.246)										
Previous Live Births (Ref: None)															
One						-0.297									
						(0.252)									

Two or More	0.599**								
	(0.298)								
WIC (Ref: No)		-0.604**							
		(0.306)							
Prenatal Care Insurance (Ref: Private)									
No Insurance			3.051**						
			(1.233)						
Medicaid			0.277						
			(0.252)						
Household Income (Ref: Middle/High Income)									
Poor				0.705*					
				(0.362)					
Near Poor				0.842					
				(0.531)					
Low Income				0.354					
				(0.349)					
Pre-pregnancy Diabetes (Ref: No)					0.282				
					(0.592)				
Pre-pregnancy Hypertension (Ref: No)						-0.494			
						(0.314)			
Pre-pregnancy Depression (Ref: No)							0.122		
							(0.302)		
Maternal BMI (Ref: Normal)									
Underweight								0.167	
								(0.533)	
Overweight								0.152	
								(0.317)	
Obese								-0.324	
								(0.272)	
Pregnancy Intention (Ref: Wanted to be pregnant then)									
Wanted to be pregnant later									0.593*
									(0.322)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Wanted to be pregnant sooner														0.0576	
														(0.299)	
Didn't want to be pregnant then or anytime														1.350***	
														(0.491)	
I wasn't sure what I wanted														0.680*	
														(0.390)	
Maternal Smoking (Ref: No)															0.0582
															(0.421)
Constant	7.895***	7.836***	7.916***	8.133***	8.202***	7.798***	8.160***	7.676***	7.544***	7.880***	7.946***	7.867***	7.987***	7.518***	7.886***
	(0.159)	(0.171)	(0.215)	(0.230)	(0.188)	(0.213)	(0.209)	(0.209)	(0.210)	(0.165)	(0.167)	(0.171)	(0.228)	(0.200)	(0.169)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.057	0.058	0.060	0.058	0.063	0.064	0.060	0.071	0.062	0.057	0.057	0.057	0.059	0.066	0.057

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Summary: Maternal education is a strong predictor of prenatal care timing. Prenatal care insurance and marital status have a modest correlation with maternal education as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal education because their inclusion has no effect on the bivariate coefficient.

Appendix Table 6. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal Age and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal Age (Ref: 25-29)															
<20 Years	0.959*	0.952*	-0.110	0.454	1.027**	1.208**	0.996**	0.637	0.429	0.959*	0.942*	0.939*	0.930*	0.716	0.933*
	(0.498)	(0.496)	(0.559)	(0.511)	(0.493)	(0.520)	(0.501)	(0.515)	(0.555)	(0.498)	(0.497)	(0.504)	(0.499)	(0.512)	(0.494)
20-24 Years	0.0712	0.0324	-0.304	-0.224	0.0980	0.212	0.0942	-0.229	-0.253	0.0713	0.0596	0.0677	0.0806	-0.0662	0.0612
	(0.332)	(0.333)	(0.341)	(0.338)	(0.331)	(0.345)	(0.334)	(0.344)	(0.337)	(0.333)	(0.333)	(0.332)	(0.329)	(0.348)	(0.333)
30-34 Years	0.254	0.256	0.394	0.353	0.212	0.148	0.242	0.284	0.442	0.254	0.258	0.265	0.239	0.278	0.279
	(0.327)	(0.328)	(0.323)	(0.328)	(0.334)	(0.321)	(0.330)	(0.306)	(0.326)	(0.327)	(0.326)	(0.327)	(0.328)	(0.321)	(0.328)
>=35 Years	-0.0425	-0.0465	-0.204	-0.0248	-0.0573	-0.334	-0.0542	-0.133	0.0102	-0.0426	-0.0109	-0.0338	-0.0357	-0.175	-0.0414
	(0.337)	(0.340)	(0.319)	(0.335)	(0.336)	(0.325)	(0.339)	(0.327)	(0.329)	(0.337)	(0.336)	(0.337)	(0.334)	(0.341)	(0.336)
Maternal education (Ref: College or higher)															
Less than High School			2.980***												
			(0.657)												
High School Graduate			0.489												
			(0.301)												
Some College			-0.300												
			(0.223)												
Maternal Race (Ref: White)															
Black		0.637***													
		(0.228)													
Other		0.293													
		(0.645)													
Marital Status (Ref: Not Married)				-0.929***											
				(0.280)											
Maternal Residence (Ref: Urban)					-0.470*										
					(0.251)										
Previous Live Births (Ref: None)															
One						-0.164									

	(0.269)							
Two or More	1.139***							
	(0.336)							
WIC (Ref: No)		-0.0909						
		(0.260)						
Prenatal Care Insurance (Ref: Private)								
No Insurance			4.655***					
			(1.279)					
Medicaid			0.817***					
			(0.249)					
Household Income (Ref: Middle/High Income)								
Poor				1.464***				
				(0.339)				
Near Poor				1.394**				
				(0.561)				
Low Income				0.672*				
				(0.357)				
Pre-pregnancy Diabetes (Ref: No)					0.00829			
					(0.615)			
Pre-pregnancy Hypertension (Ref: No)						-0.565		
						(0.354)		
Pre-pregnancy Depression (Ref: No)							0.194	
							(0.319)	
Maternal BMI (Ref: Normal)								
Underweight								0.240
								(0.608)
Overweight								0.240
								(0.333)
Obese								-0.326
								(0.274)
Pregnancy Intention (Ref: Wanted to be pregnant then)								

Wanted to be pregnant later														0.806**	
														(0.339)	
Wanted to be pregnant sooner														-0.0664	
														(0.315)	
Didn't want to be pregnant then or anytime														1.749***	
														(0.491)	
I wasn't sure what I wanted														1.057***	
														(0.406)	
Maternal Smoking (Ref: No)															0.552
															(0.415)
Constant	8.202***	8.126***	7.916***	8.838***	8.397***	7.921***	8.236***	7.712***	7.574***	8.202***	8.239***	8.163***	8.249***	7.800***	8.117***
	(0.202)	(0.188)	(0.215)	(0.286)	(0.239)	(0.281)	(0.225)	(0.200)	(0.200)	(0.205)	(0.206)	(0.212)	(0.278)	(0.206)	(0.208)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.003	0.006	0.060	0.013	0.006	0.020	0.003	0.039	0.024	0.003	0.005	0.004	0.006	0.022	0.006

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Summary: Maternal age is not a strong predictor of prenatal care timing. Maternal education picks up the effect of maternal age completely. Marital status, household income, and prenatal care insurance pick up about 50% of size of the coefficients of maternal age. Maternal residence, number of previous live births and pregnancy intention have a modest correlation with maternal age, as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal age.

Appendix Table 7. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal Residence and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal Residence (Ref: Urban)	-0.438*	-0.365	-0.470*	-0.701***	-0.431*	-0.474**	-0.458*	-0.581**	-0.639**	-0.440*	-0.428*	-0.438*	-0.428*	-0.494**	-0.512**
	(0.243)	(0.246)	(0.251)	(0.246)	(0.242)	(0.240)	(0.254)	(0.251)	(0.251)	(0.242)	(0.244)	(0.243)	(0.243)	(0.245)	(0.245)
Maternal Age (Ref: 25-29)															
<20 Years			1.027**												
			(0.493)												
20-24 Years			0.0980												
			(0.331)												
30-34 Years			0.212												
			(0.334)												
>=35 Years			-0.0573												
			(0.336)												
Maternal Race (Ref: White)															
Black		0.516**													
		(0.238)													
Other		0.191													
		(0.634)													
Maternal education (Ref: College or higher)															
Less than High School				2.985***											
				(0.635)											
High School Graduate				0.461											
				(0.282)											
Some College				-0.288											
				(0.197)											
Marital Status (Ref: Not Married)					-0.866***										
					(0.253)										
Previous Live Births (Ref: None)															
One						-0.302									
						(0.260)									

Two or More	0.931***								
	(0.311)								
WIC (Ref: No)		0.0936							
		(0.258)							
Prenatal Care Insurance (Ref: Private)									
No Insurance			4.657***						
			(1.304)						
Medicaid			0.888***						
			(0.235)						
Household Income (Ref: Middle/High Income)									
Poor				1.469***					
				(0.290)					
Near Poor				1.404**					
				(0.560)					
Low Income				0.617*					
				(0.357)					
Pre-pregnancy Diabetes (Ref: No)					0.0695				
					(0.620)				
Pre-pregnancy Hypertension (Ref: No)						-0.570			
						(0.349)			
Pre-pregnancy Depression (Ref: No)							0.222		
							(0.312)		
Maternal BMI (Ref: Normal)									
Underweight								0.337	
								(0.597)	
Overweight								0.251	
								(0.336)	
Obese								-0.321	
								(0.272)	
Pregnancy Intention (Ref: Wanted to be pregnant then)									
Wanted to be pregnant later									0.880***

														(0.330)	
Wanted to be pregnant sooner														-0.0763	
														(0.311)	
Didn't want to be pregnant then or anytime														1.717***	
														(0.486)	
I wasn't sure what I wanted														1.098***	
														(0.385)	
Maternal Smoking (Ref: No)															0.666
															(0.415)
Constant	8.962***	8.791***	8.866***	8.902***	9.471***	8.824***	8.951***	8.541***	8.564***	8.961***	8.986***	8.919***	8.985***	8.561***	8.967***
	(0.361)	(0.376)	(0.432)	(0.380)	(0.420)	(0.381)	(0.359)	(0.352)	(0.330)	(0.362)	(0.362)	(0.366)	(0.377)	(0.389)	(0.361)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.003	0.004	0.006	0.063	0.013	0.017	0.003	0.040	0.026	0.003	0.004	0.003	0.005	0.022	0.006

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Maternal residence is a strong predictor of prenatal care timing. Maternal education, prenatal care insurance, household income, and maternal smoking pick up about 50% of size of the coefficients of maternal residence. Maternal race and pregnancy intention have a modest correlation with maternal residence, as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal residence because their inclusion has no effect on the bivariate coefficient.

Appendix Table 8. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Marital Status and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Marital Status (Ref: Not Married)	-0.870***	-0.822***	-0.929***	-0.419	-0.866***	-0.841***	-1.046***	-0.746**	-0.342	-0.872***	-0.870***	-0.862***	-0.887***	-0.563**	-0.820***
	(0.254)	(0.276)	(0.280)	(0.287)	(0.253)	(0.257)	(0.267)	(0.301)	(0.326)	(0.253)	(0.254)	(0.254)	(0.254)	(0.283)	(0.258)
Maternal Age (Ref: 25-29)															
<20 Years			0.454												
			(0.511)												
20-24 Years			-0.224												
			(0.338)												
30-34 Years			0.353												
			(0.328)												
>=35 Years			-0.0248												
			(0.335)												
Maternal Race (Ref: White)															
Black		0.315													
		(0.268)													
Other		0.175													
		(0.654)													
Maternal education (Ref: College or higher)															
Less than High School				2.833***											
				(0.640)											
High School Graduate				0.354											
				(0.287)											
Some College				-0.0111											
				(0.217)											
Maternal Residence (Ref: Urban)					-0.431*										
					(0.242)										
Previous Live Births (Ref: None)															
One						-0.228									
						(0.265)									
Two or More						0.932***									

	(0.312)								
WIC (Ref: No)		-0.428*							
		(0.257)							
Prenatal Care Insurance (Ref: Private)									
No Insurance			4.562***						
			(1.311)						
Medicaid			0.420						
			(0.270)						
Household Income (Ref: Middle/High Income)									
Poor				1.156***					
				(0.367)					
Near Poor				1.164**					
				(0.542)					
Low Income				0.424					
				(0.392)					
Pre-pregnancy Diabetes (Ref: No)					0.131				
					(0.606)				
Pre-pregnancy Hypertension (Ref: No)						-0.602*			
						(0.341)			
Pre-pregnancy Depression (Ref: No)							0.0764		
							(0.308)		
Maternal BMI (Ref: Normal)									
Underweight								0.186	
								(0.589)	
Overweight								0.190	
								(0.328)	
Obese								-0.417	
								(0.273)	
Pregnancy Intention (Ref: Wanted to be pregnant then)									
Wanted to be pregnant later									0.667*
									(0.354)
Wanted to be pregnant sooner									-0.0400

														(0.307)	
Didn't want to be pregnant then or anytime														1.513***	
														(0.498)	
I wasn't sure what I wanted														0.889**	
														(0.413)	
Maternal Smoking (Ref: No)															0.284
															(0.420)
Constant	8.865***	8.789***	8.838***	8.133***	9.040***	8.636***	9.148***	8.408***	8.021***	8.863***	8.906***	8.846***	8.964***	8.287***	8.793***
	(0.214)	(0.254)	(0.286)	(0.230)	(0.244)	(0.238)	(0.264)	(0.302)	(0.331)	(0.215)	(0.218)	(0.224)	(0.255)	(0.304)	(0.223)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.010	0.011	0.013	0.058	0.013	0.023	0.012	0.042	0.022	0.010	0.011	0.010	0.013	0.022	0.011

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Marital status is a strong predictor of prenatal care timing. Maternal education, WIC receipt and pregnancy intention are rather strongly correlated with marital status, as they pick up about 50% of size of the coefficients of marital status. Maternal age and prenatal care insurance have a modest correlation with marital status, as they change the bivariate coefficients by about 10%. No other covariates are correlated with marital status because their inclusion has no effect on the bivariate coefficient.

Appendix Table 9. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Previous Live Births and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Previous Live Births (Ref: None)															
One	-0.326	-0.334	-0.164	-0.297	-0.228	-0.302	-0.328	-0.255	-0.330	-0.327	-0.325	-0.326	-0.296	-0.382	-0.331
	(0.260)	(0.259)	(0.269)	(0.252)	(0.265)	(0.260)	(0.261)	(0.260)	(0.259)	(0.260)	(0.260)	(0.260)	(0.261)	(0.260)	(0.260)
Two or More	0.896***	0.876***	1.139***	0.599**	0.932***	0.931***	0.899***	0.682**	0.634**	0.896***	0.898***	0.898***	0.918***	0.620*	0.854***
	(0.312)	(0.314)	(0.336)	(0.298)	(0.312)	(0.311)	(0.311)	(0.302)	(0.311)	(0.312)	(0.312)	(0.312)	(0.312)	(0.333)	(0.322)
Maternal Age (Ref: 25-29)															
<20 Years			1.208**												
			(0.520)												
20-24 Years			0.212												
			(0.345)												
30-34 Years			0.148												
			(0.321)												
>=35 Years			-0.334												
			(0.325)												
Maternal Race (Ref: White)															
Black		0.577**													
		(0.228)													
Other		0.266													
		(0.644)													
Maternal education (Ref: College or higher)															
Less than High School				2.815***											
				(0.636)											
High School Graduate				0.412											
				(0.276)											
Some College				-0.0739											
				(0.191)											
Marital Status (Ref: Not Married)					-0.841***										
					(0.257)										

Maternal Residence (Ref: Urban)	-0.474**								
	(0.240)								
WIC (Ref: No)		-0.0631							
		(0.246)							
Prenatal Care Insurance (Ref: Private)									
No Insurance			4.239***						
			(1.253)						
Medicaid			0.661***						
			(0.225)						
Household Income (Ref: Middle/High Income)									
Poor				1.153***					
				(0.286)					
Near Poor				1.209**					
				(0.545)					
Low Income				0.460					
				(0.350)					
Pre-pregnancy Diabetes (Ref: No)					0.0210				
					(0.610)				
Pre-pregnancy Hypertension (Ref: No)						-0.603*			
						(0.351)			
Pre-pregnancy Depression (Ref: No)							0.236		
							(0.310)		
Maternal BMI (Ref: Normal)									
Underweight								0.183	
								(0.565)	
Overweight								0.199	
								(0.333)	
Obese								-0.385	
								(0.270)	
Pregnancy Intention (Ref: Wanted to be pregnant then)									
Wanted to be pregnant later									0.797**

														(0.335)	
Wanted to be pregnant sooner														-0.0416	
														(0.306)	
Didn't want to be pregnant then or anytime														1.381***	
														(0.517)	
I wasn't sure what I wanted														0.937**	
														(0.399)	
Maternal Smoking (Ref: No)															0.389
															(0.424)
Constant	8.173***	8.104***	7.921***	7.798***	8.636***	8.350***	8.199***	7.715***	7.714***	8.173***	8.213***	8.127***	8.236***	7.856***	8.130***
	(0.188)	(0.184)	(0.281)	(0.213)	(0.238)	(0.209)	(0.216)	(0.188)	(0.187)	(0.186)	(0.192)	(0.203)	(0.243)	(0.202)	(0.182)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.014	0.016	0.020	0.064	0.023	0.017	0.014	0.044	0.028	0.014	0.015	0.014	0.017	0.027	0.015

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Number of previous live births is a strong predictor of prenatal care timing. Maternal age picks up about 50% of size of the coefficients of number of previous live births. Maternal education, pregnancy intention, marital status, and prenatal care insurance have a modest correlation with number of previous live births, as they change the bivariate coefficients by about 10%. No other covariates are correlated with number of previous live births because their inclusion has no effect on the bivariate coefficient.

Appendix Table 10. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal Smoking and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal Smoking (Ref: No)	0.558	0.590	0.552	0.0582	0.284	0.666	0.389	0.608	0.436	0.0136	0.566	0.529	0.558	0.539	0.238
	(0.413)	(0.410)	(0.415)	(0.421)	(0.420)	(0.415)	(0.424)	(0.436)	(0.434)	(0.445)	(0.412)	(0.407)	(0.412)	(0.410)	(0.418)
Maternal Age (Ref: 25-29)															
<20 Years			0.933*												
			(0.494)												
20-24 Years			0.0612												
			(0.333)												
30-34 Years			0.279												
			(0.328)												
>=35 Years			-0.0414												
			(0.336)												
Maternal Race (Ref: White)															
Black		0.669***													
		(0.223)													
Other		0.344													
		(0.638)													
Maternal education (Ref: College or higher)															
Less than High School				2.916***											
				(0.640)											
High School Graduate				0.413											
				(0.280)											
Some College				-0.151											
				(0.200)											
Marital Status (Ref: Not Married)					-0.820***										
					(0.258)										
Maternal Residence (Ref: Urban)						-0.512**									
						(0.245)									
Previous Live Births (Ref: None)							-0.331								

One	(0.260)							
	0.854***							
Two or More	(0.322)							
WIC (Ref: No)		-0.127						
		(0.263)						
Prenatal Care Insurance (Ref: Private)								
No Insurance			4.614***					
			(1.286)					
Medicaid			0.681***					
			(0.239)					
Household Income (Ref: Middle/High Income)								
Poor				1.359***				
				(0.309)				
Near Poor				1.299**				
				(0.566)				
Low Income				0.537				
				(0.356)				
Pre-pregnancy Hypertension (Ref: No)					-0.614*			
					(0.354)			
Pre-pregnancy Depression (Ref: No)						0.123		
						(0.302)		
Pre-pregnancy Diabetes (Ref: No)							-0.0104	
							(0.596)	
Maternal BMI (Ref: Normal)								
Underweight								0.226
								(0.579)
Overweight								0.228
								(0.334)
Obese								-0.347
								(0.273)
Pregnancy Intention (Ref: Wanted to be pregnant then)								

Wanted to be pregnant later															0.843***
															(0.324)
Wanted to be pregnant sooner															-0.0769
															(0.312)
Didn't want to be pregnant then or anytime															1.642***
															(0.491)
I wasn't sure what I wanted															1.024***
															(0.394)
Constant	8.260***	8.163***	8.117***	7.886***	8.793***	8.454***	8.130***	8.305***	7.757***	7.717***	8.300***	8.241***	8.260***	8.318***	7.852***
	(0.122)	(0.131)	(0.208)	(0.169)	(0.223)	(0.154)	(0.182)	(0.146)	(0.120)	(0.120)	(0.127)	(0.135)	(0.126)	(0.205)	(0.170)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.002	0.005	0.006	0.057	0.011	0.006	0.015	0.002	0.037	0.021	0.003	0.002	0.002	0.005	0.019

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Maternal smoking is not a strong predictor of prenatal care timing. Maternal education and household income pick up the effect of maternal smoking completely. Marital status, number of previous live births, and pregnancy intention pick up about 50% of size of the coefficients of maternal smoking. Prenatal care insurance, maternal residence, and WIC have a modest correlation with maternal smoking, as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal smoking because their inclusion has no effect on the bivariate coefficient.

Appendix Table 11. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Maternal BMI and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Maternal BMI (Ref: Normal)															
Underweight	0.281	0.282	0.240	0.167	0.186	0.337	0.183	0.276	0.0137	-0.00708	0.261	0.263	0.281	0.201	0.226
	(0.592)	(0.596)	(0.608)	(0.533)	(0.589)	(0.597)	(0.565)	(0.589)	(0.588)	(0.580)	(0.592)	(0.584)	(0.592)	(0.588)	(0.579)
Overweight	0.226	0.211	0.240	0.152	0.190	0.251	0.199	0.226	0.202	0.189	0.242	0.220	0.226	0.258	0.228
	(0.335)	(0.329)	(0.333)	(0.317)	(0.328)	(0.336)	(0.333)	(0.334)	(0.327)	(0.329)	(0.336)	(0.333)	(0.335)	(0.329)	(0.334)
Obese	-0.357	-0.372	-0.326	-0.324	-0.417	-0.321	-0.385	-0.360	-0.439	-0.515*	-0.322	-0.377	-0.357	-0.369	-0.347
	(0.272)	(0.266)	(0.274)	(0.272)	(0.273)	(0.272)	(0.270)	(0.272)	(0.272)	(0.274)	(0.275)	(0.273)	(0.271)	(0.273)	(0.273)
Maternal Age (Ref: 25-29)															
<20 Years			0.930*												
			(0.499)												
20-24 Years			0.0806												
			(0.329)												
30-34 Years			0.239												
			(0.328)												
>=35 Years			-0.0357												
			(0.334)												
Maternal Race (Ref: White)															
Black		0.676***													
		(0.228)													
Other		0.257													
		(0.630)													
Maternal education (Ref: College or higher)															
Less than High School				2.875***											
				(0.636)											
High School Graduate				0.421											
				(0.279)											
Some College				-0.208											
				(0.197)											

Marital Status (Ref: Not Married)	-0.887***								
	(0.254)								
Maternal Residence (Ref: Urban)		-0.428*							
		(0.243)							
Previous Live Births (Ref: None)									
One			-0.296						
			(0.261)						
Two or More			0.918***						
			(0.312)						
WIC (Ref: No)				0.0292					
				(0.249)					
Prenatal Care Insurance (Ref: Private)									
No Insurance					4.619***				
					(1.296)				
Medicaid					0.808***				
					(0.232)				
Household Income (Ref: Middle/High Income)									
Poor						1.416***			
						(0.286)			
Near Poor						1.377**			
						(0.559)			
Low Income						0.617*			
						(0.350)			
Pre-pregnancy Hypertension (Ref: No)							-0.523		
							(0.352)		
Pre-pregnancy Depression (Ref: No)								0.260	
								(0.311)	
Pre-pregnancy Diabetes (Ref: No)									0.0151
									(0.620)
Pregnancy Intention (Ref: Wanted to be pregnant then)									

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Wanted to be pregnant later														0.893***	
														(0.330)	
Wanted to be pregnant sooner														-0.0337	
														(0.314)	
Didn't want to be pregnant then or anytime														1.679***	
														(0.487)	
I wasn't sure what I wanted														1.117***	
														(0.387)	
Maternal Smoking (Ref: No)															0.539
															(0.410)
Constant	8.400***	8.325***	8.249***	7.987***	8.964***	8.985***	8.236***	8.389***	7.858***	7.811***	8.420***	8.359***	8.400***	7.908***	8.318***
	(0.193)	(0.181)	(0.278)	(0.228)	(0.255)	(0.377)	(0.243)	(0.220)	(0.177)	(0.186)	(0.194)	(0.202)	(0.195)	(0.197)	(0.205)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.003	0.006	0.006	0.059	0.013	0.005	0.017	0.003	0.040	0.025	0.004	0.004	0.003	0.022	0.005

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Maternal BMI is not a strong predictor of prenatal care timing. Prenatal care insurance and household income pick up about 50% of the size of the coefficients of maternal BMI. Marital status, number of previous live births, maternal education, and maternal residence have a modest correlation with maternal BMI, as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal BMI because their inclusion has no effect on the bivariate coefficient.

Appendix Table 12. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Pre-Pregnancy Diabetes and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Pre-pregnancy Diabetes (Ref: No)	0.00658	-0.000659	0.00829	0.282	0.131	0.0695	0.0210	0.00638	0.133	0.137	0.563	-0.124	0.0151	0.121	-0.0104
	(0.613)	(0.615)	(0.615)	(0.592)	(0.606)	(0.620)	(0.610)	(0.619)	(0.612)	(0.582)	(0.810)	(0.624)	(0.620)	(0.629)	(0.596)
Maternal Age (Ref: 25-29)															
<20 Years			0.959*												
			(0.498)												
20-24 Years			0.0713												
			(0.333)												
30-34 Years			0.254												
			(0.327)												
>=35 Years			-0.0426												
			(0.337)												
Maternal Race (Ref: White)															
Black		0.640***													
		(0.225)													
Other		0.283													
		(0.641)													
Maternal education (Ref: College or higher)															
Less than High School				2.935***											
				(0.637)											
High School Graduate				0.425											
				(0.283)											
Some College				-0.152											
				(0.195)											
Marital Status (Ref: Not Married)					-0.872***										
					(0.253)										
Maternal Residence (Ref: Urban)						-0.440*									
						(0.242)									

Previous Live Births (Ref: None)							
One	-0.327 (0.260)						
Two or More	0.896*** (0.312)						
WIC (Ref: No)		-0.00172 (0.249)					
Prenatal Care Insurance (Ref: Private)							
No Insurance			4.600*** (1.286)				
Medicaid			0.774*** (0.224)				
Household Income (Ref: Middle/High Income)							
Poor				1.365*** (0.286)			
Near Poor				1.304** (0.553)			
Low Income				0.540 (0.350)			
Pre-pregnancy Hypertension (Ref: No)					-0.801 (0.508)		
Pre-pregnancy Depression (Ref: No)						0.238 (0.320)	
Maternal BMI (Ref: Normal)							
Underweight							0.281 (0.592)
Overweight							0.226 (0.335)

Obese													-0.357 (0.271)		
Pregnancy Intention (Ref: Wanted to be pregnant then)															
Wanted to be pregnant later														0.869*** (0.330)	
Wanted to be pregnant sooner														-0.0793 (0.310)	
Didn't want to be pregnant then or anytime														1.696*** (0.490)	
I wasn't sure what I wanted														1.060*** (0.386)	
Maternal Smoking (Ref: No)															0.558 (0.412)
Constant	8.343*** (0.122)	8.258*** (0.133)	8.202*** (0.205)	7.880*** (0.165)	8.863*** (0.215)	8.522*** (0.156)	8.173*** (0.186)	8.344*** (0.154)	7.772*** (0.125)	7.711*** (0.128)	8.378*** (0.125)	8.302*** (0.132)	8.400*** (0.195)	7.869*** (0.171)	8.260*** (0.126)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.000	0.003	0.003	0.057	0.010	0.003	0.014	0.000	0.036	0.021	0.002	0.000	0.003	0.019	0.002

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Pre-pregnancy diabetes is not a strong predictor of prenatal care timing. Maternal age and WIC have a modest correlation with pre-pregnancy diabetes. All other covariates completely pick up the effect of pre-pregnancy diabetes.

Appendix Table 13. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Pre-Pregnancy Depression and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Pre-pregnancy Depression (Ref: No)	0.223	0.236	0.194	0.122	0.0764	0.222	0.236	0.227	0.191	-0.0732	0.320	0.238	0.260	0.0746	0.123
	(0.312)	(0.310)	(0.319)	(0.302)	(0.308)	(0.312)	(0.310)	(0.312)	(0.308)	(0.307)	(0.325)	(0.320)	(0.311)	(0.313)	(0.302)
Maternal Age (Ref: 25-29)															
<20 Years			0.939*												
			(0.504)												
20-24 Years			0.0677												
			(0.332)												
30-34 Years			0.265												
			(0.327)												
>=35 Years			-0.0338												
			(0.337)												
Maternal Race (Ref: White)															
Black		0.648***													
		(0.225)													
Other		0.294													
		(0.639)													
Maternal education (Ref: College or higher)															
Less than High School				2.926***											
				(0.636)											
High School Graduate				0.415											
				(0.281)											
Some College				-0.143											
				(0.197)											
Marital Status (Ref: Not Married)					-0.862***										
					(0.254)										
Maternal Residence (Ref: Urban)						-0.438*									
						(0.243)									
Previous Live Births (Ref: None)															
One							-0.326								

	(0.260)							
Two or More	0.898***							
	(0.312)							
WIC (Ref: No)		-0.0240						
		(0.247)						
Prenatal Care Insurance (Ref: Private)								
No Insurance			4.608***					
			(1.286)					
Medicaid			0.750***					
			(0.224)					
Household Income (Ref: Middle/High Income)								
Poor				1.377***				
				(0.286)				
Near Poor				1.303**				
				(0.554)				
Low Income				0.542				
				(0.352)				
Pre-pregnancy Hypertension (Ref: No)					-0.706*			
					(0.370)			
Pre-pregnancy Diabetes (Ref: No)						-0.124		
						(0.624)		
Maternal BMI (Ref: Normal)								
Underweight							0.263	
							(0.584)	
Overweight							0.220	
							(0.333)	
Obese							-0.377	
							(0.273)	
Pregnancy Intention (Ref: Wanted to be pregnant then)								
Wanted to be pregnant later								0.862***
								(0.329)

Wanted to be pregnant sooner														-0.0812	
														(0.311)	
Didn't want to be pregnant then or anytime														1.685***	
														(0.490)	
I wasn't sure what I wanted														1.051***	
														(0.391)	
Maternal Smoking (Ref: No)															0.529
															(0.407)
Constant	8.300***	8.212***	8.163***	7.867***	8.846***	8.481***	8.127***	8.310***	7.752***	7.726***	8.330***	8.302***	8.359***	7.863***	8.241***
	(0.132)	(0.140)	(0.212)	(0.171)	(0.224)	(0.164)	(0.203)	(0.157)	(0.127)	(0.130)	(0.134)	(0.132)	(0.202)	(0.173)	(0.135)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.000	0.003	0.004	0.057	0.010	0.003	0.014	0.000	0.036	0.021	0.002	0.000	0.004	0.019	0.002

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary: Pre-pregnancy depression is not a strong predictor of prenatal care timing. Marital status and pregnancy intention pick up the effect of pre-pregnancy depression completely. Maternal smoking, maternal education, and pre-pregnancy hypertension pick up about 50% of size of the coefficients of pre-pregnancy depression. Maternal age and prenatal care insurance have a modest correlation with pre-pregnancy depression as they change the bivariate coefficients by about 10%. No other covariates are correlated with maternal smoking because their inclusion has no effect on the bivariate coefficient.

Appendix Table 14. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Pre-Pregnancy Hypertension and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Pre-pregnancy Hypertension (Ref: No)	-0.599*	-0.625*	-0.565	-0.494	-0.602*	-0.570	-0.603*	-0.599*	-0.506	BMI	-0.801	-0.706*	-0.599*	-0.610*	-0.614*
	(0.351)	(0.350)	(0.354)	(0.314)	(0.341)	(0.349)	(0.351)	(0.351)	(0.349)	(0.349)	(0.508)	(0.370)	(0.351)	(0.359)	(0.354)
Maternal Age (Ref: 25-29)															
<20 Years			0.942*												
			(0.497)												
20-24 Years			0.0596												
			(0.333)												
30-34 Years			0.258												
			(0.326)												
>=35 Years			-0.0109												
			(0.336)												
Maternal Race (Ref: White)															
Black		0.669***													
		(0.224)													
Other		0.260													
		(0.641)													
Maternal education (Ref: College or higher)															
Less than High School				2.888***											
				(0.637)											
High School Graduate				0.395											
				(0.281)											
Some College				-0.185											
				(0.195)											
Marital Status (Ref: Not Married)					-0.870***										
					(0.254)										
Maternal Residence (Ref: Urban)						-0.428*									
						(0.244)									
Previous Live Births (Ref: None)															
One							-0.325								

	(0.260)							
Two or More	0.898***							
	(0.312)							
WIC (Ref: No)		0.00509						
		(0.247)						
Prenatal Care Insurance (Ref: Private)								
No Insurance			4.563***					
			(1.286)					
Medicaid			0.772***					
			(0.223)					
Household Income (Ref: Middle/High Income)								
Poor				1.357***				
				(0.285)				
Near Poor				1.310**				
				(0.552)				
Low Income				0.534				
				(0.349)				
Pre-pregnancy Diabetes (Ref: No)					0.563			
					(0.810)			
Pre-pregnancy Depression (Ref: No)						0.320		
						(0.325)		
Maternal BMI (Ref: Normal)								
Underweight							0.261	
							(0.592)	
Overweight							0.242	
							(0.336)	
Obese							-0.322	
							(0.275)	
Pregnancy Intention (Ref: Wanted to be pregnant then)								
Wanted to be pregnant later								0.853***
								(0.329)

Wanted to be pregnant sooner														-0.0641	
														(0.311)	
Didn't want to be pregnant then or anytime														1.699***	
														(0.491)	
I wasn't sure what I wanted														1.071***	
														(0.386)	
Maternal Smoking (Ref: No)															0.566
															(0.412)
Constant	8.383***	8.299***	8.239***	7.946***	8.906***	8.558***	8.213***	8.381***	7.812***	7.759***	8.378***	8.330***	8.420***	7.912***	8.300***
	(0.126)	(0.137)	(0.206)	(0.167)	(0.218)	(0.158)	(0.192)	(0.153)	(0.125)	(0.128)	(0.125)	(0.134)	(0.194)	(0.170)	(0.127)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.001	0.004	0.005	0.057	0.011	0.004	0.015	0.001	0.037	0.022	0.002	0.002	0.004	0.020	0.003

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary: Pre-pregnancy hypertension is a semi-strong predictor of prenatal care timing. Maternal education, prenatal care insurance, and pre-pregnancy diabetes have a modest correlation with pre-pregnancy hypertension as they change the bivariate coefficients by about 10%. No other covariates are correlated with pre-pregnancy hypertension because their inclusion has no effect on the bivariate coefficient.

Appendix Table 15. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Prenatal Care Insurance and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Prenatal Care Insurance (Ref: Private)															
No Insurance	4.595***	4.656***	4.655***	3.051**	4.562***	4.657***	4.239***	4.601***	4.148***	4.600***	4.563***	4.608***	4.619***	4.495***	4.614***
	(1.286)	(1.303)	(1.279)	(1.233)	(1.311)	(1.304)	(1.253)	(1.285)	(1.248)	(1.286)	(1.286)	(1.286)	(1.296)	(1.279)	(1.286)
Medicaid	0.772***	0.728***	0.817***	0.277	0.420	0.888***	0.661***	1.062***	0.0306	0.774***	0.772***	0.750***	0.808***	0.498**	0.681***
	(0.223)	(0.228)	(0.249)	(0.252)	(0.270)	(0.235)	(0.225)	(0.328)	(0.356)	(0.224)	(0.223)	(0.224)	(0.232)	(0.230)	(0.239)
Maternal Age (Ref: 25-29)															
<20 Years			0.637												
			(0.515)												
20-24 Years			-0.229												
			(0.344)												
30-34 Years			0.284												
			(0.306)												
>=35 Years			-0.133												
			(0.327)												
Maternal Race (Ref: White)															
Black		0.502**													
		(0.243)													
Other		-0.174													
		(0.660)													
Maternal education (Ref: College or higher)															
Less than High School				2.430***											
				(0.639)											
High School Graduate				0.330											
				(0.281)											
Some College				-0.0391											
				(0.222)											
Marital Status (Ref: Not Married)					-0.746**										
					(0.301)										

Maternal Residence (Ref: Urban)	-0.581**								
	(0.251)								
Previous Live Births (Ref: None)									
One		-0.255							
		(0.260)							
Two or More		0.682**							
		(0.302)							
WIC (Ref: No)			-0.478						
			(0.342)						
Household Income (Ref: Middle/High Income)									
Poor				1.259***					
				(0.420)					
Near Poor				1.259**					
				(0.587)					
Low Income				0.412					
				(0.393)					
Pre-pregnancy Diabetes (Ref: No)					0.133				
					(0.612)				
Pre-pregnancy Hypertension (Ref: No)						-0.506			
						(0.349)			
Pre-pregnancy Depression (Ref: No)							0.191		
							(0.308)		
Maternal BMI (Ref: Normal)									
Underweight								0.0137	
								(0.588)	
Overweight								0.202	
								(0.327)	
Obese								-0.439	
								(0.272)	
Pregnancy Intention (Ref: Wanted to be pregnant then)									
Wanted to be pregnant later									0.777**

														(0.312)	
Wanted to be pregnant sooner														0.0666	
														(0.305)	
Didn't want to be pregnant then or anytime														1.585***	
														(0.500)	
I wasn't sure what I wanted														0.968**	
														(0.386)	
Maternal Smoking (Ref: No)															0.436
															(0.434)
Constant	7.778***	7.758***	7.712***	7.676***	8.408***	7.960***	7.715***	7.830***	7.610***	7.772***	7.812***	7.752***	7.858***	7.482***	7.757***
	(0.121)	(0.127)	(0.200)	(0.209)	(0.302)	(0.144)	(0.188)	(0.119)	(0.116)	(0.125)	(0.125)	(0.127)	(0.177)	(0.153)	(0.120)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.036	0.038	0.039	0.071	0.042	0.040	0.044	0.038	0.048	0.036	0.037	0.036	0.040	0.050	0.037

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: Prenatal care insurance is a strong predictor of prenatal care timing. Maternal education has a strong correlation with prenatal care insurance as it changes the bivariate coefficient by about 34%. No other covariates are correlated with prenatal care insurance because their inclusion has no effect on the bivariate coefficient.

Appendix Table 16. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and WIC and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
WIC (Ref: No)	-0.00182	-0.0454	-0.0909	-0.604**	-0.428*	0.0936	-0.0631	-0.478	-0.959***	-0.00172	0.00509	-0.0240	0.0292	-0.227	-0.127
	(0.247)	(0.252)	(0.260)	(0.306)	(0.257)	(0.258)	(0.246)	(0.342)	(0.353)	(0.249)	(0.247)	(0.247)	(0.249)	(0.260)	(0.263)
Maternal Age (Ref: 25-29)															
<20 Years			0.996**												
			(0.501)												
20-24 Years			0.0942												
			(0.334)												
30-34 Years			0.242												
			(0.330)												
>=35 Years			-0.0542												
			(0.339)												
Maternal Race (Ref: White)															
Black		0.648***													
		(0.234)													
Other		0.286													
		(0.644)													
Maternal education (Ref: College or higher)															
Less than High School				3.038***											
				(0.637)											
High School Graduate				0.545*											
				(0.301)											
Some College				-0.382*											
				(0.225)											
Marital Status (Ref: Not Married)					-1.046***										
					(0.267)										
Maternal Residence (Ref: Urban)						-0.458*									
						(0.254)									
Previous Live Births (Ref: None)															

One	-0.328							
	(0.261)							
Two or More	0.899***							
	(0.311)							
Prenatal Care Insurance (Ref: Private)								
No Insurance		4.601***						
		(1.285)						
Medicaid		1.062***						
		(0.328)						
Household Income (Ref: Middle/High Income)								
Poor			1.971***					
			(0.404)					
Near Poor			1.756***					
			(0.561)					
Low Income			0.899**					
			(0.403)					
Pre-pregnancy Diabetes (Ref: No)				0.00638				
				(0.619)				
Pre-pregnancy Hypertension (Ref: No)					-0.599*			
					(0.351)			
Pre-pregnancy Depression (Ref: No)						0.227		
						(0.312)		
Maternal BMI (Ref: Normal)								
Underweight							0.276	
							(0.589)	
Overweight							0.226	
							(0.334)	
Obese							-0.360	
							(0.272)	
Pregnancy Intention (Ref: Wanted to be pregnant then)								
Wanted to be pregnant later								0.911***

														(0.339)	
Wanted to be pregnant sooner														-0.0790	
														(0.313)	
Didn't want to be pregnant then or anytime														1.738***	
														(0.494)	
I wasn't sure what I wanted														1.105***	
														(0.393)	
Maternal Smoking (Ref: No)															0.608
															(0.436)
Constant	8.344***	8.276***	8.236***	8.160***	9.148***	8.951***	8.199***	7.830***	7.812***	8.344***	8.381***	8.310***	8.389***	7.948***	8.305***
	(0.149)	(0.149)	(0.225)	(0.209)	(0.264)	(0.359)	(0.216)	(0.119)	(0.123)	(0.154)	(0.153)	(0.157)	(0.220)	(0.176)	(0.146)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.000	0.003	0.003	0.060	0.012	0.003	0.014	0.038	0.029	0.000	0.001	0.000	0.003	0.019	0.002

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Summary: WIC is not a strong predictor of prenatal care timing. Maternal race, maternal age, maternal education, marital status, maternal residence, number of previous live births, prenatal care insurance, household income, pre-pregnancy hypertension, pre-pregnancy depression, maternal BMI, pregnancy intention, and maternal smoking pick up its effect completely. Pre-pregnancy diabetes has a weak correlation with WIC as it changes the bivariate coefficient by about 6%.

Appendix Table 17. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Pregnancy Intention and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Pregnancy Intention (Ref: Wanted to be pregnant then)															
Wanted to be pregnant later	0.866***	0.838**	0.806**	0.593*	0.667*	0.880***	0.797**	0.911***	0.777**	0.602*	0.853***	0.862***	0.869***	0.893***	0.843***
	(0.330)	(0.334)	(0.339)	(0.322)	(0.354)	(0.330)	(0.335)	(0.339)	(0.312)	(0.355)	(0.329)	(0.329)	(0.330)	(0.330)	(0.324)
Wanted to be pregnant sooner	-0.0789	-0.0785	-0.0664	0.0576	-0.0400	-0.0763	-0.0416	-0.0790	0.0666	-0.0711	-0.0641	-0.0812	-0.0793	-0.0337	-0.0769
	(0.311)	(0.313)	(0.315)	(0.299)	(0.307)	(0.311)	(0.306)	(0.313)	(0.305)	(0.306)	(0.311)	(0.311)	(0.310)	(0.314)	(0.312)
Didn't want to be pregnant then or anytime	1.693***	1.643***	1.749***	1.350***	1.513***	1.717***	1.381***	1.738***	1.585***	1.326***	1.699***	1.685***	1.696***	1.679***	1.642***
	(0.490)	(0.497)	(0.491)	(0.491)	(0.498)	(0.486)	(0.517)	(0.494)	(0.500)	(0.504)	(0.491)	(0.490)	(0.490)	(0.487)	(0.491)
I wasn't sure what I wanted	1.059***	1.021***	1.057***	0.680*	0.889**	1.098***	0.937**	1.105***	0.968**	0.776*	1.071***	1.051***	1.060***	1.117***	1.024***
	(0.386)	(0.391)	(0.406)	(0.390)	(0.413)	(0.385)	(0.399)	(0.393)	(0.386)	(0.403)	(0.386)	(0.391)	(0.386)	(0.387)	(0.394)
Maternal Age (Ref: 25-29)															
<20 Years			0.716												
			(0.512)												
20-24 Years			-0.0662												
			(0.348)												
30-34 Years			0.278												
			(0.321)												
>=35 Years			-0.175												
			(0.341)												
Maternal Race (Ref: White)															
Black		0.339													
		(0.238)													
Other		0.211													
		(0.630)													
Maternal education (Ref: College or higher)															
Less than High School				2.816***											
				(0.651)											
High School Graduate				0.411											
				(0.274)											

Some College	-0.00243								
	(0.193)								
Marital Status (Ref: Not Married)		-0.563**							
		(0.283)							
Maternal Residence (Ref: Urban)			-0.494**						
			(0.245)						
Previous Live Births (Ref: None)									
One				-0.382					
				(0.260)					
Two or More				0.620*					
				(0.333)					
WIC (Ref: No)					-0.227				
					(0.260)				
Prenatal Care Insurance (Ref: Private)									
No Insurance						4.495***			
						(1.279)			
Medicaid						0.498**			
						(0.230)			
Household Income (Ref: Middle/High Income)									
Poor							1.065***		
							(0.313)		
Near Poor							1.072*		
							(0.571)		
Low Income							0.399		
							(0.351)		
Pre-pregnancy Hypertension (Ref: No)								-0.610*	
								(0.359)	
Pre-pregnancy Depression (Ref: No)									0.0746
									(0.313)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Pre-pregnancy Diabetes (Ref: No)													0.121		
													(0.629)		
Maternal BMI (Ref: Normal)															
Underweight														0.201	
														(0.588)	
Overweight														0.258	
														(0.329)	
Obese														-0.369	
														(0.273)	
Maternal Smoking (Ref: No)															0.238
															(0.418)
Constant	7.874***	7.838***	7.800***	7.518***	8.287***	8.066***	7.856***	7.948***	7.482***	7.511***	7.912***	7.863***	7.869***	7.908***	7.852***
	(0.167)	(0.180)	(0.206)	(0.200)	(0.304)	(0.197)	(0.202)	(0.176)	(0.153)	(0.150)	(0.170)	(0.173)	(0.171)	(0.197)	(0.170)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.019	0.020	0.022	0.066	0.022	0.022	0.027	0.019	0.050	0.030	0.020	0.019	0.019	0.022	0.019

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary: Pregnancy intention is a strong predictor of prenatal care timing. No covariates pick up the effect of pregnancy intention completely. Maternal education, marital status, number of previous live births, household income, and prenatal care insurance have a modest correlation with pre-pregnancy depression as they change the bivariate coefficients by about 10%. No other covariates are correlated with pregnancy intention because their inclusion has no effect on the bivariate coefficient.

Appendix Table 18. Estimation of the Bivariate Association of Week Gestation of Prenatal Care Initiation and Household Income and the Assessment of Inclusion of Other Covariates on the Association

COVARIATES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Household Income (Ref: Middle/High Income)															
Poor	1.363***	1.314***	1.464***	0.705*	1.156***	1.469***	1.153***	1.971***	1.259***	1.365***	1.357***	1.377***	1.416***	1.065***	1.359***
	(0.285)	(0.302)	(0.339)	(0.362)	(0.367)	(0.290)	(0.286)	(0.404)	(0.420)	(0.286)	(0.285)	(0.286)	(0.286)	(0.313)	(0.309)
Near Poor	1.301**	1.282**	1.394**	0.842	1.164**	1.404**	1.209**	1.756***	1.259**	1.304**	1.310**	1.303**	1.377**	1.072*	1.299**
	(0.553)	(0.555)	(0.561)	(0.531)	(0.542)	(0.560)	(0.545)	(0.561)	(0.587)	(0.553)	(0.552)	(0.554)	(0.559)	(0.571)	(0.566)
Low Income	0.538	0.518	0.672*	0.354	0.424	0.617*	0.460	0.899**	0.412	0.540	0.534	0.542	0.617*	0.399	0.537
	(0.350)	(0.345)	(0.357)	(0.349)	(0.392)	(0.357)	(0.350)	(0.403)	(0.393)	(0.350)	(0.349)	(0.352)	(0.350)	(0.351)	(0.356)
Maternal Age (Ref: 25-29)															
<20 Years			0.429												
			(0.555)												
20-24 Years			-0.253												
			(0.337)												
30-34 Years			0.442												
			(0.326)												
>=35 Years			0.0102												
			(0.329)												
Maternal Race (Ref: White)															
Black		0.339													
		(0.250)													
Other		0.112													
		(0.654)													
Maternal education (Ref: College or higher)															
Less than High School				2.736***											
				(0.680)											
High School Graduate				0.282											
				(0.294)											
Some College				0.140											
				(0.222)											
Marital Status (Ref: Not Married)					-0.342										

	(0.326)									
Maternal Residence (Ref: Urban)		-0.639**								
		(0.251)								
Previous Live Births (Ref: None)										
One			-0.330							
			(0.259)							
Two or More			0.634**							
			(0.311)							
WIC (Ref: No)				-0.959***						
				(0.353)						
Prenatal Care Insurance (Ref: Private)										
No Insurance					4.148***					
					(1.248)					
Medicaid					0.0306					
					(0.356)					
Pre-pregnancy Diabetes (Ref: No)						0.137				
						(0.582)				
Pre-pregnancy Hypertension (Ref: No)							-0.587*			
							(0.349)			
Pre-pregnancy Depression (Ref: No)								-0.0732		
								(0.307)		
Maternal BMI (Ref: Normal)										
Underweight									-0.00708	
									(0.580)	
Overweight									0.189	
									(0.329)	
Obese									-0.515*	
									(0.274)	
Pregnancy Intention (Ref: Wanted to be pregnant then)										
Wanted to be pregnant later										0.602*

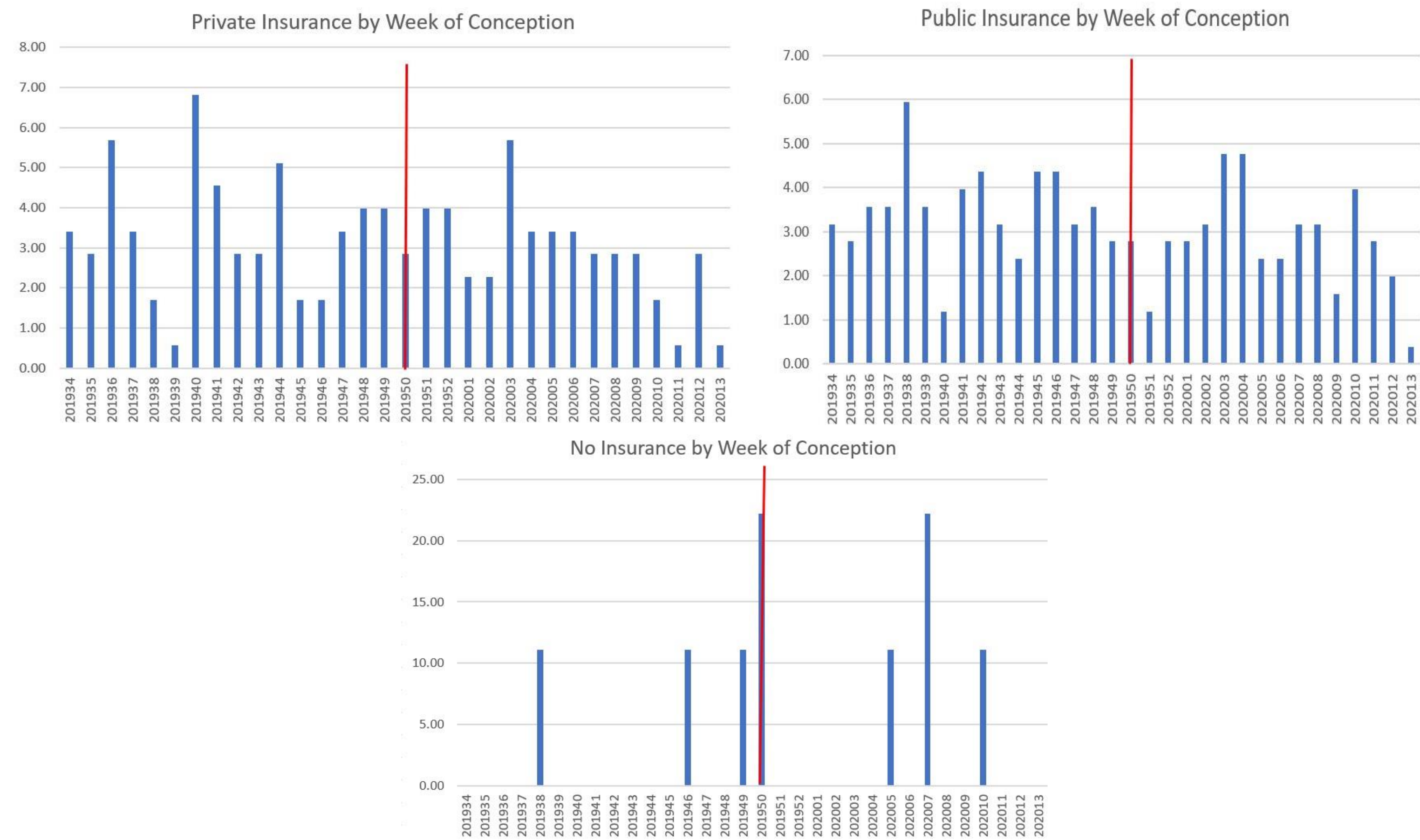
														(0.355)	
Wanted to be pregnant sooner														-0.0711	
														(0.306)	
Didn't want to be pregnant then or anytime														1.326***	
														(0.504)	
I wasn't sure what I wanted														0.776*	
														(0.403)	
Maternal Smoking (Ref: No)															0.0136
															(0.445)
Constant	7.717***	7.695***	7.574***	7.544***	8.021***	7.925***	7.714***	7.812***	7.610***	7.711***	7.759***	7.726***	7.811***	7.511***	7.717***
	(0.123)	(0.129)	(0.200)	(0.210)	(0.331)	(0.133)	(0.187)	(0.123)	(0.116)	(0.128)	(0.128)	(0.130)	(0.186)	(0.150)	(0.120)
Observations	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
R-squared	0.021	0.021	0.024	0.062	0.022	0.026	0.028	0.029	0.048	0.021	0.022	0.021	0.025	0.030	0.021

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

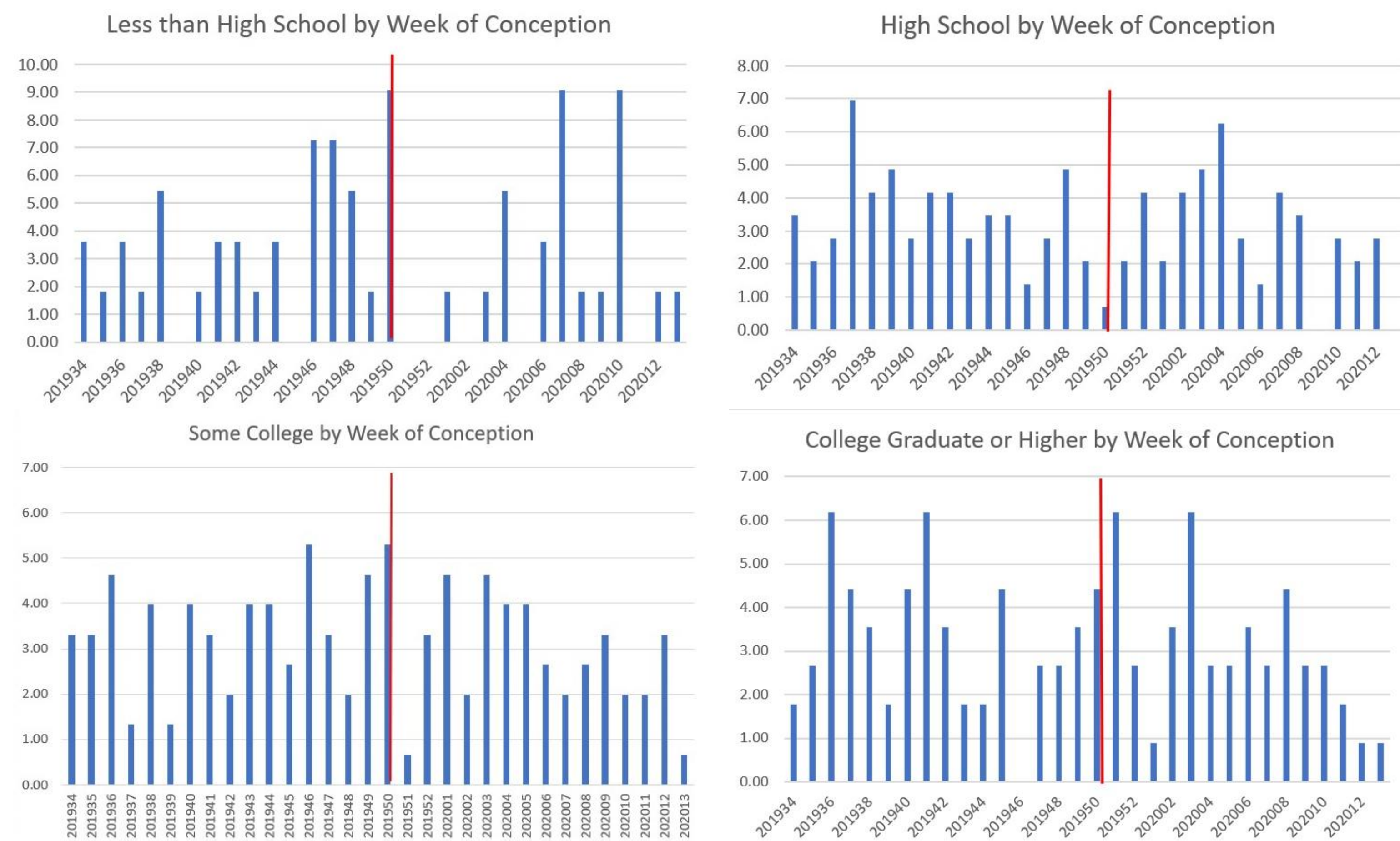
Summary: Household income is a strong predictor of prenatal care timing. No covariates pick up the effect of household income completely. WIC, pregnancy intention, and maternal education are strongly correlated with household income as they pick up about 50% of the effect of household income. Maternal age, maternal residence, marital status, number of previous live births, and prenatal care insurance have a modest correlation with household income as they change the bivariate coefficients by about 10%. No other covariates are correlated with household income because their inclusion has no effect on the bivariate coefficient.

Appendix Figure 1. Plots of Smoothness of Covariates at the Cutoff (Week 50), Prenatal Care Insurance, 2019-2020



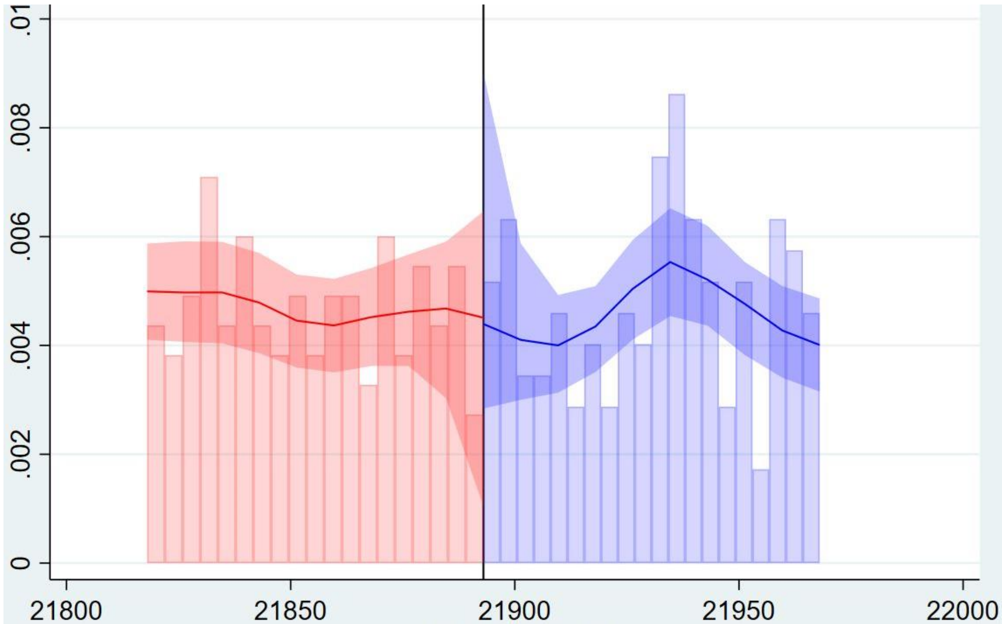
**Red line indicates cutoff at Week 50 of 2019

Appendix Figure 2. Plots of Smoothness of Covariates at the Cutoff (Week 50), Maternal Education, 2019-2020



**Red line indicates cutoff at Week 50 of 2019

Appendix Figure 3. Density Plot of Running Variable (assumed date of conception) at Cutoff by Week of Conception (2019-2020)



**Black line indicates cutoff at Week 50 of 2019

Appendix Table 19. Estimates of Effects of COVID-19 on Timing of Prenatal Care Initiation by Year, Adjusted and Unadjusted Linear and Quadratic Models, Optimal Bandwidth

	Unadjusted		Adjusted	
	Linear	Quadratic	Linear	Quadratic
2019-2020	3.3462*	3.5431*	1.4324	0.51985
	(1.71740)	(1.82220)	(1.10620)	(1.29310)
2018-2019	-1.3212	-1.7101	-0.28459	-2.1942
	(2.18260)	(2.42490)	(1.12410)	(1.80360)
2017-2018	-1.5229	-1.9234	-1.6932	-2.7194
	(1.48110)	(1.87580)	(1.24650)	(1.75500)
2016-2017	2.0274	3.6984	-	-
	(3.2127)	(3.7773)	-	-

*p<0.1, **p<0.05, ***p<0.01
Robust standard errors in parentheses

CURRICULUM VITAE

Melissa B. Eggen, MPH

EDUCATION

University of Louisville
Louisville, KY
Doctor of Philosophy in Public Health Sciences
May 2024
Specialization: Health Management and Policy

University of Illinois at Chicago
Chicago, IL
Master of Public Health
May 2008
Concentration: Maternal and Child Health
Master's Thesis: *Women's Preferences for the Location of Abortion Services: A Pilot Study in Two Chicago Clinics*

University of Kentucky
Lexington, KY
Bachelor of Arts, Anthropology
May 2004
Minor: Japanese language

RESEARCH ACTIVITIES

Role	**Principal Investigator**
Source	Kentucky Cabinet for Health and Family Services
Type	State University Partnership
Title	Assessing Policies and Systems to Improve Maternal and Infant Health in Kentucky
Dates	7/2023-6/2024
Total Amount	$357,774

Role	Co-Investigator
Name of PI	Jeremy Gaskins, PhD, University of Louisville

Source	Kentucky Cabinet for Health and Family Services
Type	State University Partnership
Title	Racial and Geographic Disparities in Maternal Outcomes During COVID-19
Dates	7/2023-6/2024
Total Amount	$283,223

Role	Co-Investigator
Name of PI	Danielle Bessett, PhD, University of Cincinnati
Source	Society of Family Planning
Type	Grant
Title	Reproductive Health Equity in Kentucky After Dobbs
Dates	7/2022-6/2024
Total Amount	$49,471

PEER REVIEWED PUBLICATIONS

Eggen MB, Petrey J, Roberson P, Curnutte M, Jennings JC. (2023). An exploration of barriers to access to trial of labor and vaginal birth after cesarean in the United States: a scoping review. *Journal of Perinatal Medicine,* 51(8): 981-991. doi:10.1515/jpm-2022-0364.

Eggen, MB, Jennings, JC, O'Keefe, M, Kelly Pryor, B, Clements, L. (2020). "Advancing Social Determinants of Health through Advancements in Post-Secondary Attainment and Sustaining Employment." *The Foundation Review,* 12(3): 19-31.

Eggen, MB, Handler, A, Godfrey, EM. (2012). "Women's Preferences for the Location of Abortion Services: A Pilot Study in Two Chicago Clinics." *Maternal Child Health Journal,* 16(1): 212-216.

NON-PEER REVIEWED PUBLICATIONS AND ONLINE CONTENT

Inside Philanthropy. The State of American Philanthropy. "Giving for Rural Communities." Published November 2023.

Vu, G, Little, B, Goldsby, M, Ali Parh, Y, Karimi, S, Lai, P, Cheng, G, **Eggen, MB**. (June 2023). Association Between Dental Prophylaxis and Pneumonia in Kentucky Medicaid Beneficiaries.

Eggen, MB, Goins, J, Johnson, CE, Karimi, S. (May 2023). Issue Brief: Improving the Health of Kentuckians: The Value of an All-Payer Claims Database.

Schaefer, B, Creel, L, Choate, S, Yewell, K, Karimi, S, **Eggen, M,** Howard, T. (March 2023). Research Brief: Early Learnings from Louisville Metro's Crisis Call Diversion Program.

Creel, L, Wattles, B, Smith, M, **Eggen, M,** Karimi, S. Commonwealth Institute of Kentucky. (February 2023). Policy Brief: Policy Options to Improve Outpatient Antibiotic Prescribing in the Pediatric Medicaid Population in Kentucky.

Karimi, S, Goldsby, M, Little, B, Vu, G, Patel, N, Zarei, H, **Eggen, M**. Commonwealth Institute of Kentucky. (November 2022). Research Brief: Medicaid Managed Care and the Utilization of Non-Office-Based Services Among Kentucky Medicaid Beneficiaries with Chronic Disease.

Karimi, S, Goldsby, M, Little, B, Vu, G, Patel, N, Zarei, H, **Eggen, M.** Commonwealth Institute of Kentucky. (October 2022). Research Brief: Medicaid Managed Care and the Utilization of Office-Based Services Among Kentucky Medicaid Beneficiaries with Chronic Disease.

Kong, M, Kulasekera, KB, McClain, C, Mitra, R, Pal, S, Huang, H, Hu, H, Han, Y, **Eggen, M,** Karimi, S. (October 2022). Commonwealth Institute of Kentucky. Research Brief: Depressive and Anxiety Disorders Among Medicaid Beneficiaries in Kentucky.

Kong, M, Kulasekera, KB, McClain, C, Mitra, R, Pal, S, Huang, H, Hu, H, Han, Y, **Eggen, M,** Karimi, S. (September 2022). Commonwealth Institute of Kentucky. Research Brief: An Assessment of Alcohol Use Disorder and Treatment Utilization among Medicaid Beneficiaries in Kentucky.

Curnutte, M, **Eggen, M,** Yewell, K. (August 2022). Commonwealth Institute of Kentucky. Issue Brief: Policy Considerations to Address Chronic Disease in Kentucky.

Eggen, M, Curnutte, M, Jennings, JC. (August 2022). Strategies for Addressing Financial Well-Being: Research Findings from a Series of Qualitative Interviews. Report for The Humana Foundation.

Eggen, Melissa. (July 13, 2022). Interview with Louisville Public Radio Affiliate, 89.3 WFPL. "Kentucky Lacking in Prenatal Care as More Could Need It Post-Roe."

Eggen, M, Yewell, K, Creel, L. (June 2022). Commonwealth Institute of Kentucky. Issue Brief: Kentucky Extends Medicaid to One Year Postpartum.

Eggen, Melissa. (June 30, 2022). "The Evidence is Clear: The Loss of Abortion Access will be Devastating for Kentucky." *Louisville Courier-Journal.* Op-Ed.

Eggen, M, Stanev, N, Creel, L. (February 2022). Commonwealth Institute of Kentucky. Issue Brief: Maternal Mortality in Kentucky.

PROFESSIONAL PRESENTATIONS AND PANELS

Eggen, Melissa. Invited Presentation at the University of Louisville Student Health Law Association Lunch. February 13, 2023. Louisville, KY.

Eggen, Melissa. "Centering Birthing People in the Childbirth Experience." **Oral Presentation** at The Missouri Convening for Maternal and Infant Health. September 28, 2022. St. Louis, MO.

Eggen, Melissa. "Advancing Equity in Black Maternal Health." Webinar Panel for Kentuckiana Health Collaborative. **Panel Moderator.** August 30, 2022.

Eggen, Melissa. Predictors of the Timing of Prenatal Care Initiation in Kentucky PRAMS Cohorts, 2017-2020. **Oral Presentation** at Kentucky Public Health Association Annual Conference. April 21, 2022. Bowling Green, KY.

Eggen, MB. Maternal Mortality in Kentucky. **Panel Presentation** at Kentuckiana Health Collaborative Annual Conference. Panel Member. April 13, 2022. Louisville, KY.

RISE Community Development Workshop. Panelist. "Health Equity Group Training". August 2016. St. Louis, MO.

Collective Impact Forum. Workshop Facilitator. "Needles in the Haystack: How to Discover, Nurture and Support Capacity in Rural Places to Move Collective Impact." June 2016. Seattle, WA.
Collective Impact Forum. Peer Assist Facilitator. October 2015. Chicago, IL.

Healthcare Georgia Foundation. Invited speaker for Annual Board of Directors Retreat. September 2015. St. Simons, GA.

Grantmakers in Health. Workshop Presentation. "Learning Lab: Evaluating Collective Impact." March 2015. Austin, TX.

Eggen, MB., Handler, A., Godfrey, EM. Women's Preferences for the Location of Abortion Services: A Pilot Study at Two Chicago Clinics. **Poster Presentation** at the Association of Reproductive Health Professionals meeting. Washington, D.C. September 2008.

POSTER PRESENTATIONS

Priddy, M, Schaefer, B, Choate, S, **Eggen, M.** "An Audience-Centered Approach to Translate Best Practices and Policy Recommendations for Transforming Crisis Response: A Case Study**." Poster Presentation** at Kentucky Public Health Association Annual Research Meeting in Louisville, KY. March 6-8, 2024.

Smith, MH, **Eggen, MB**, Prestrud, AA, Lafferty, D, Bessett, D, King, E. "Seeking financial and practical support in an abortion-hostile state: Analysis of abortion fund data in Kentucky, 2014-2021." **Poster Presentation** at Society for Family Planning Annual Research Meeting in Seattle, WA. October 27, 2023.

Pugh, F, **Eggen, MB,** Jackson, C, Karimi, S. "Trends in Congenital Syphilis and Associated Birth Outcomes in Jefferson County, Kentucky." **Poster Presentation** at Research!Louisville. October 4, 2023. Louisville, KY.

Eggen, MB, Schaefer, B, Choate, S, Collins, K, Creel, L, Howard, T, Karimi, S, Kay, H, Yewell, K. "Utilization of an Alternative Responder Model to Address Behavioral Health Care Related to Calls to 911 in Louisville, Kentucky." **Poster Presentation** at AcademyHealth in Seattle, WA. June 24-27, 2023.

Eggen, MB, Choate, S, Collins, K, Creel, L, Howard, T, Karimi, S, Kay, H, Schaefer, B, Yewell, K. "Utilization of an Alternative Responder Model to Address Behavioral Health Care Related Calls to 911 in Louisville, Kentucky." **Poster Presentation** at Research!Louisville. September 21, 2022. Louisville, KY.

Eggen, MB, Jennings, JC, Creel, L. An Exploration of Geographic and Racial/Ethnic Disparities in Vaginal Birth after Cesarean: A Review of the Literature. **Poster presentation** at AcademyHealth. June 4-7, 2022. Washington, DC.

Eggen, MB, Creel, L. Maternal Mortality in Kentucky. **Poster presentation** at Kentucky Public Health Association Annual Conference. April 24-27, 2022. Bowling Green, KY.

Eggen, MB, Jennings, JC, Creel, L. An Exploration of Geographic and Racial/Ethnic Disparities in Vaginal Birth after Cesarean: A Review of the Literature. **Poster presentation** at the Kentucky Public Health Association Annual Conference. April 24-27, 2022. Bowling Green, KY.

Curnutte, M, Salunkhe, S, Morshedul, A, **Eggen, MB.** Access to Care to Reduce Health Disparities in West Louisville. **Poster presentation** at Center for Healthcare Organization Transformation National Meeting. March 24-25, 2022. Louisville, KY.

Eggen, MB, Creel, L. Impact of the Affordable Care Act's Contraceptive Coverage Mandate on the Use of Contraception among Privately Insured Women in the United States: A Systematic Review. **Poster presentation** at the CityMatCH Annual Conference. Virtual Meeting. December 2021.

Eggen, MB. Impact of the Affordable Care Act's Contraceptive Coverage Mandate on the Use of Contraception among Privately Insured Women in the United States: A Systematic Review. **Poster presentation** at the Kentucky Public Health Association Annual Conference. Virtual Meeting. April 2021.

Eggen, MB, Johnson, CE. Partnering for Impact: Insights from the University of Louisville's Center for Health Organization Transformation. **Poster presentation** at Kentucky Public Health Association Annual Conference. Virtual Meeting. May 2020.

TEACHING AND COURSE DEVELOPMENT

Instructor for PHMS 708-Population Health and Health Disparities. Fall 2023.
University of Louisville School of Public Health and Information Sciences.

Course Development and Instructor for PHMS 705-Mixed & Qualitative Research Methods for Health Services Research. Spring 2023.
University of Louisville School of Public Health and Information Sciences.

HONORS AND AWARDS

John M. Houchens Prize for Outstanding Dissertation. Spring 2024.

Dean's Citation Award. Spring 2024.

Excellence in Health Disparities Research Award. 1st place. Research!Louisville for Pugh, F, **Eggen, MB,** Jackson, C, Karimi, S. "Trends in Congenital Syphilis and Associated Birth Outcomes in Jefferson County, Kentucky." October 4, 2023. Louisville, KY.

University of Louisville. 3-Minute Thesis Competition. Runner-Up. "Can Data Save Lives? Who is—and Who Isn't—Receiving Early Prenatal Care in Kentucky?" November 3, 2023.

RELEVANT WORK EXPERIENCE

University of Louisville **July 2019-Present**
Instructor **Louisville, KY**

- Teach doctoral-level courses in Population Health and Health Disparities (PHMS 708) and Qualitative and Mixed Methods in Health Services Research (PHMS 650);

- Serve as PI on one State University Partnership award to investigate maternal and infant health policies in Kentucky and their impact on outcomes.

Program Manager & Senior Policy Analyst

- Provide project management and research support for various projects;
- Assist with the recruitment of new industry partners;
- Assist with research dissemination, including through social media and newsletter development;
- Participate in grantwriting to support research activities;
- Develop and write research and policy briefs on a variety of topics.

Obici Healthcare Foundation **November 2017-May 2019**
Program Officer **Suffolk, VA**

- Responsible for Foundation investments of $2.5 million per year in Maternal and Child Health and Strengthening the Safety Net;
- Worked with community organizations to co-design the foundational strategy for Maternal and Child Health—a five-year plan for improving maternal mental health that focused on network building and community capacity, specifically planning, building data capacity, equity and community engagement;
- Conducted focus groups and community interviews to guide the design of the foundational strategy for Strengthening the Safety Net, which focused on operational support for safety net organizations in the service region.

Missouri Foundation for Health **November 2011-November 2017**
Program Officer **St. Louis, MO**

- Created and managed funding strategies related to women's reproductive health and infant mortality reduction;
    - Developed a strategy for two collective impact initiatives—one rural and one urban—to reduce infant deaths, focused on racial equity;
    - Developed and led a community learning collaborative designed to create more opportunity for collective learning and capacity building related to infant outcomes;
- Designed and implemented a community reviewer process to facilitate the inclusion of community voice in proposal review.
- Led a team in the development of a $30 million multi-pronged investment to increase access to contraception, specifically focused on reproductive health justice;
- Worked across the Foundation's other investment areas, including the Opportunity Fund, by reviewing grants, assisting with strategy development and contributing ideas;
- Led the Foundation's emerging work on gun violence prevention, including leading the development of the first two grants from the Foundation related to gun violence.

Washington University in St. Louis, School of Medicine April 2010-November 2011
Evaluation Coordinator, Clinical Research Training Center **St. Louis, MO**

- Served as the lead evaluator for a National Institute of Health grant to support clinical research training programs, including data collection, survey design, data analysis and developing recommendations for program enhancements and improvements;
- Supported grant writing and evaluation planning for other grant funding opportunities.

TEACHING

University of Louisville School of Public Health and Information Sciences
PHMS 708: Population Health and Health Disparities, Fall 2023 (12 students); role (sole instructor); 3 cr

PHMS 650: Qualitative Research Methods, Spring 2024 (6 students); role (course developer and sole instructor); 3 cr

REVIEWER EXPERIENCE

PLOS Global Public Health. Reviewer. (2023, 2022).
The Foundation Review. Reviewer. (2023, 2020).
Health Resources and Services Administration (HRSA). (2022). Grant reviewer for "Small Health Care Provider Quality Improvement Program."
Cardinal Edge. University of Louisville's Undergraduate Research Journal. Manuscript review. (2022)
American Public Health Association Annual Conference Abstract Reviewer (2017 and 2018), Film Reviewer (2018)
CityMatCH Conference Abstract Reviewer (2017)
St. Louis Arch Grants Reviewer (2017 and 2018)
Robert Wood Johnson Foundation Culture of Health Leaders Application Reviewer (2017)
Grantmakers in Health Abstract Reviewer (2016, 2018, 2019)

SERVICE

Board Member. The Milk Bank. January 2022-Present.
Kentucky Maternal Mortality Task Force. Member. November 2022-Present
Kentucky Perinatal Quality Collaborative. Member. August 2021-Present.