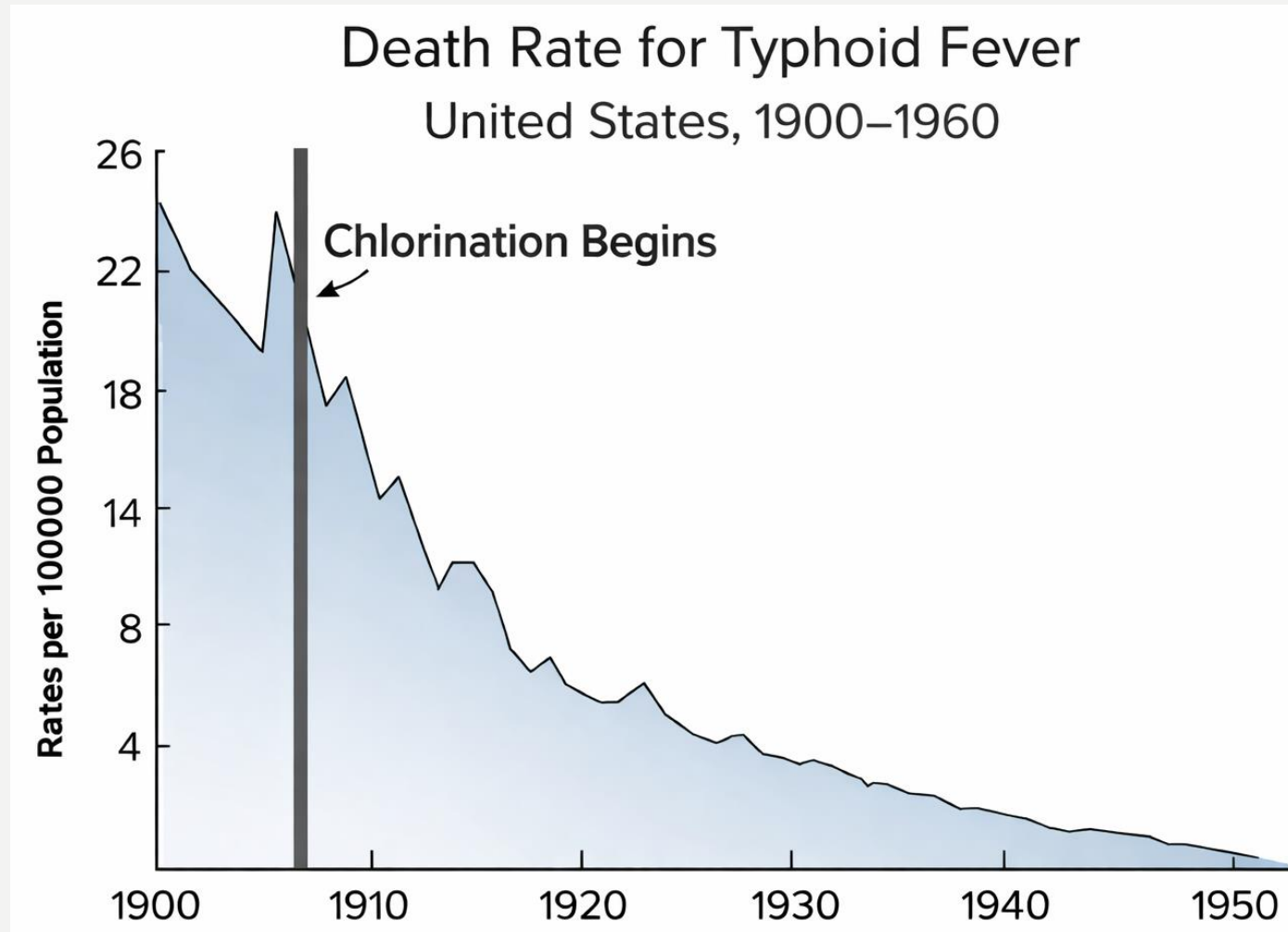


UNCOVERING HEALTH RISKS OF DRINKING WATER CONTAMINATION

EVIDENCE FROM NITRATE EXPOSURE AND BIRTH OUTCOMES

**ELIZABETH SORENSEN MONTOYA
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KANSAS STATE UNIVERSITY**

EARLY WATER TREATMENT AND HEALTH



Source: U.S. Centers for Disease Control and Prevention, *Summary of Notifiable Diseases*, 1997
image quality enhanced with AI

TODAY'S RISKS ARE HARDER TO SEE

- Smaller
- Chronic
- Less visible

REGULATING CONTAMINATION: THE SAFE DRINKING WATER ACT (SDWA)

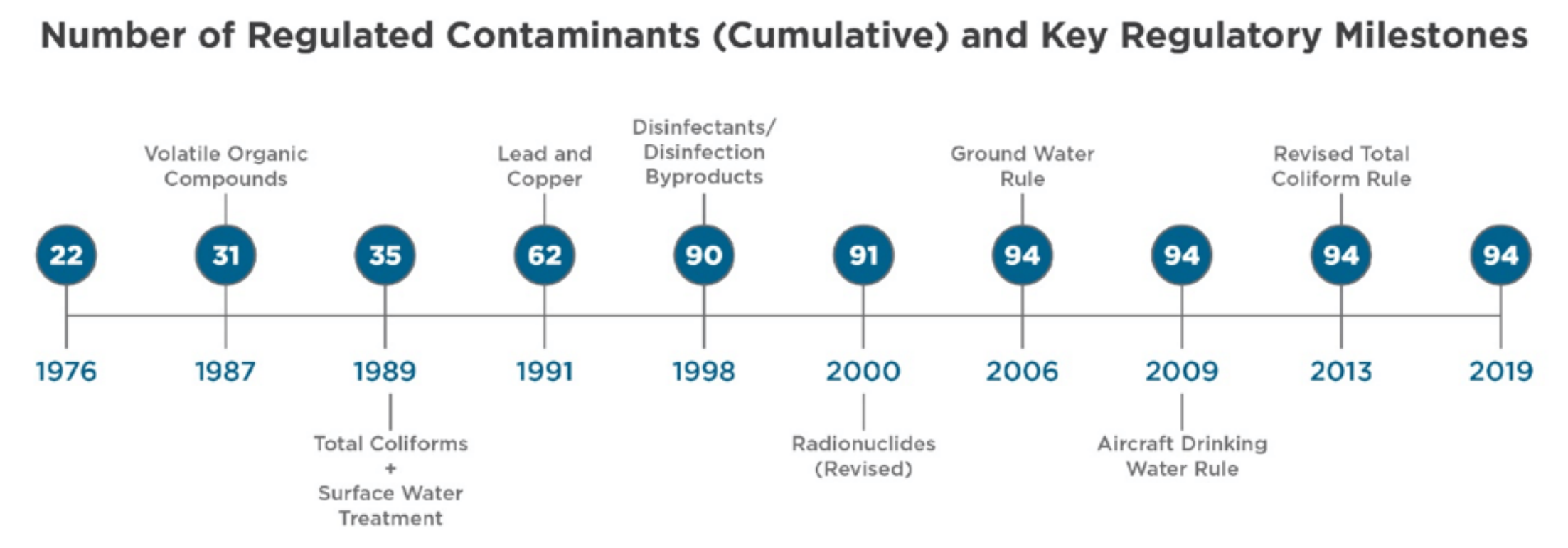
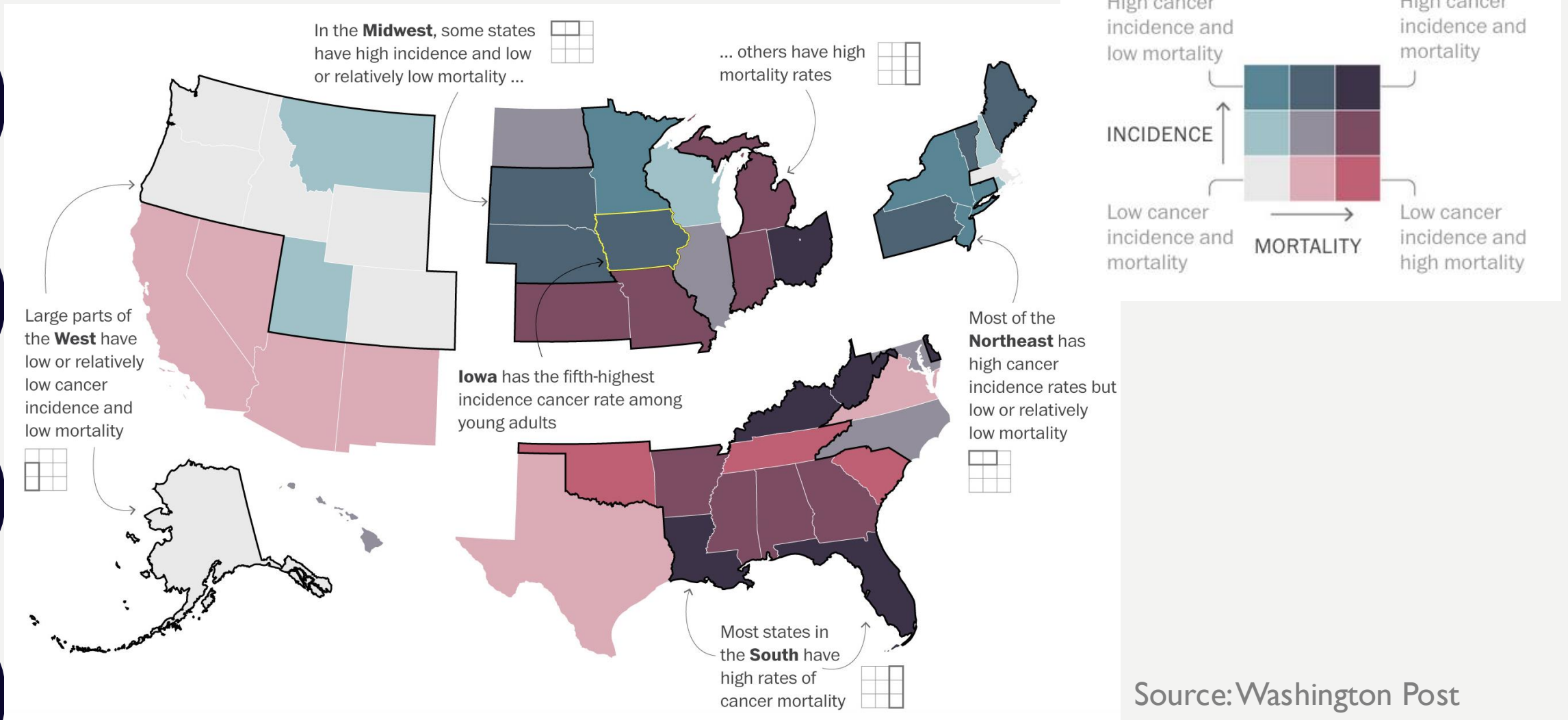


Figure credit: River Network, Drinking Water Guide: A Resource for Advocates

UNCOVERING HEALTH RISKS—NO SMALL TASK



Source: Washington Post

CDC most recent four years of data for cancer incidence (2018-2022) and mortality (2019-2023). 2020 was not included because of changes in diagnoses during the covid-19 pandemic.

HOW DO WE ISOLATE THE EFFECT?

What we need:

- Clean variation in contamination
- Comparable populations
- Changes over time

So, what does this look like in practice?

UNCOVERING RISK: NITRATE IN DRINKING WATER

- Nitrate
 - One of the most prevalent contaminants in U.S. drinking water
 - Well-established acute risk to infants at levels $> 10\text{mg/L}$
 - “Blue baby syndrome”
 - Safe Drinking Water Act MCL set to 10mg/L in 1991

UNCOVERING RISK: NITRATE IN DRINKING WATER

- Between 1997 and 2014, population served by systems with nitrate violations fell by ~86%
 - (Pennino et al., 2017)
- In 2014:
 - **~200,000 people** served by systems with nitrate violations
 - (Pennino et al., 2017)
 - **~5.6 million people** served by systems with nitrate $\geq 5\text{mg/L}$
 - (Schaidler et al., 2019)

**WHAT IS THE EFFECT
OF LOW-LEVEL
NITRATE EXPOSURE?**






Contents lists available at [ScienceDirect](#)

Journal of Environmental Economics and Management

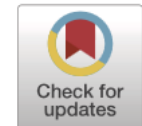
journal homepage: www.elsevier.com/locate/yjeem



Birth outcome effects of nitrate contamination in drinking water[☆]

Elizabeth Sorensen Montoya 

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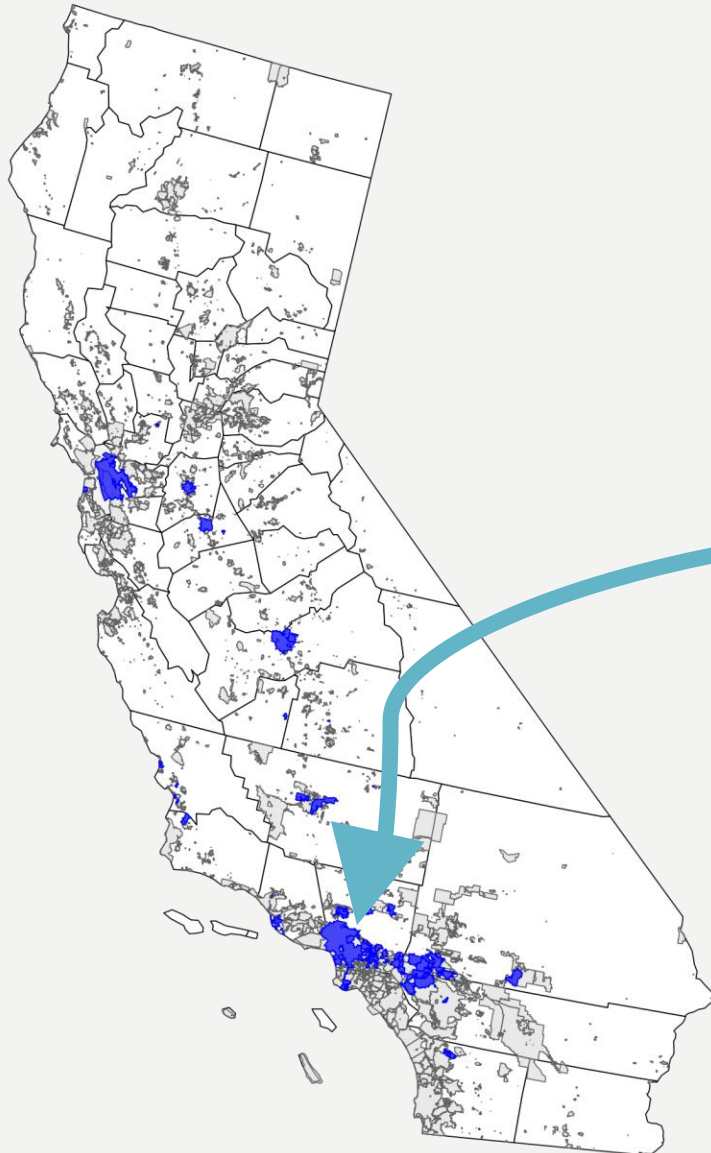


This research was approved by the California Committee for the Protection of Human Subjects and the University of Colorado Boulder institutional review boards.

TWO BIG NEEDS

- High-frequency nitrate data
- Birth outcome data with spatial link

MONTHLY NITRATE SAMPLES



STATE OF CALIFORNIA
CERTIFICATION OF VITAL RECORD

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC HEALTH

CERTIFICATE OF LIVE BIRTH
STATE OF CALIFORNIA
USE BLACK INK ONLY

1. SEX MALE		2. MARRIAGE STATUS SINGLE		3. RACE 0518	
4. PLACE OF BIRTH PROVIDENCE SAINT JOHN'S HEALTH CTR		5. STREET ADDRESS - STREET AND NUMBER OR LOCATION 2121 SANTA MONICA BOULEVARD			
6. CITY SANTA MONICA		7. COUNTY LOS ANGELES			
8. NAME OF FATHER - FIRST D KISELEVA, MD		9. NAME OF FATHER - LAST MD		10. OCCUPATION FATHER	
11. DATE OF BIRTH 02/02/2016		12. DATE OF DEATH 02/02/2016		13. DATE OF REGISTRATION 02/05/2016	
14. SIGNATURE AND TITLE OF REGISTRAR JEFFREY D GUNZENHAUSER, MD SS					

CERTIFIED COPY OF VITAL RECORD
STATE OF CALIFORNIA, COUNTY OF LOS ANGELES

DATE ISSUED **FEB 10 2016**

www.infinityquest.us

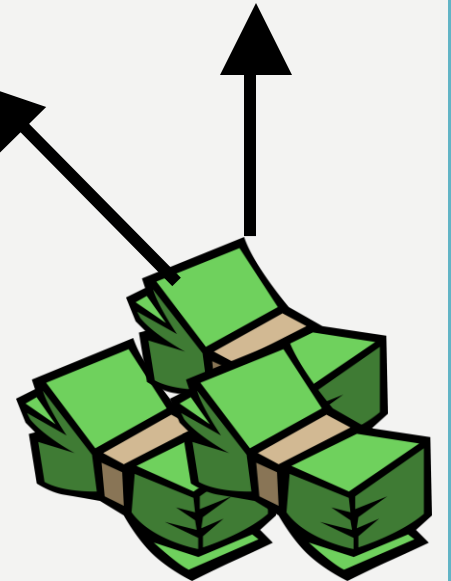
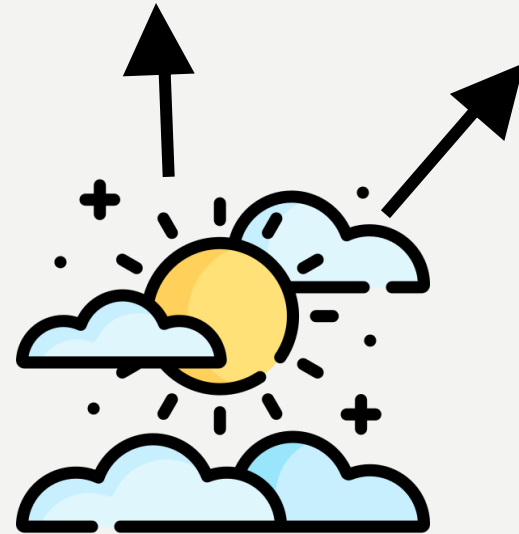
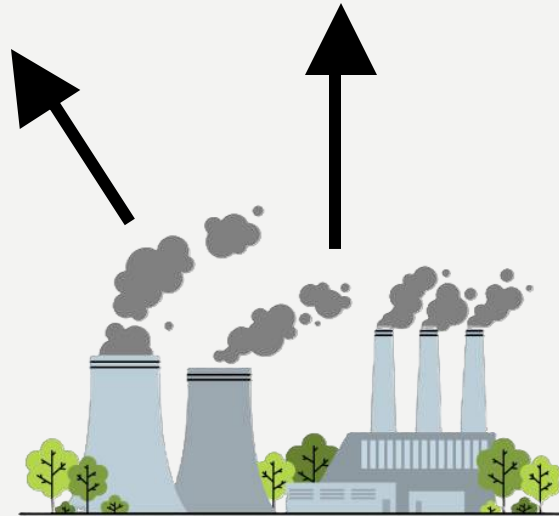
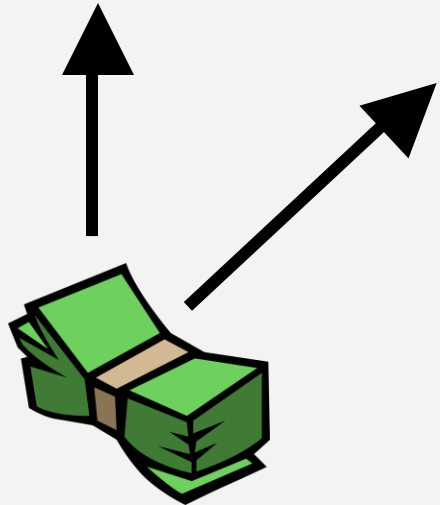
CAN'T COMPARE MOM IN HIGH NITRATE PWS TO MOM IN LOW NITRATE PWS.



Nitrate > 5mg/L



Nitrate < 5mg/L



ISOLATING THE EFFECT OF NITRATE

- Collect data & control for observable differences
 - Income, education
 - Behaviors during pregnancy
 - Other environmental factors

- Unobservable differences may remain...

ISOLATING THE EFFECT OF NITRATE

$$Y_{iwt} = \sum_{n=1}^3 (\beta_n E_{iwt}^n + \sigma_n WP_{it}^n) + \beta_4 X_{iwt} + \beta_6 WQ_{iwt} + \gamma_w + \mu_t + \epsilon_{iwt}$$

i : infant, w : water system, t : year, n : trimester

ISOLATING THE EFFECT OF NITRATE

PWS #1

Trimester 2:
Jan-Mar



Nitrate >
5mg/L



Trimester 2:
Jun-Aug

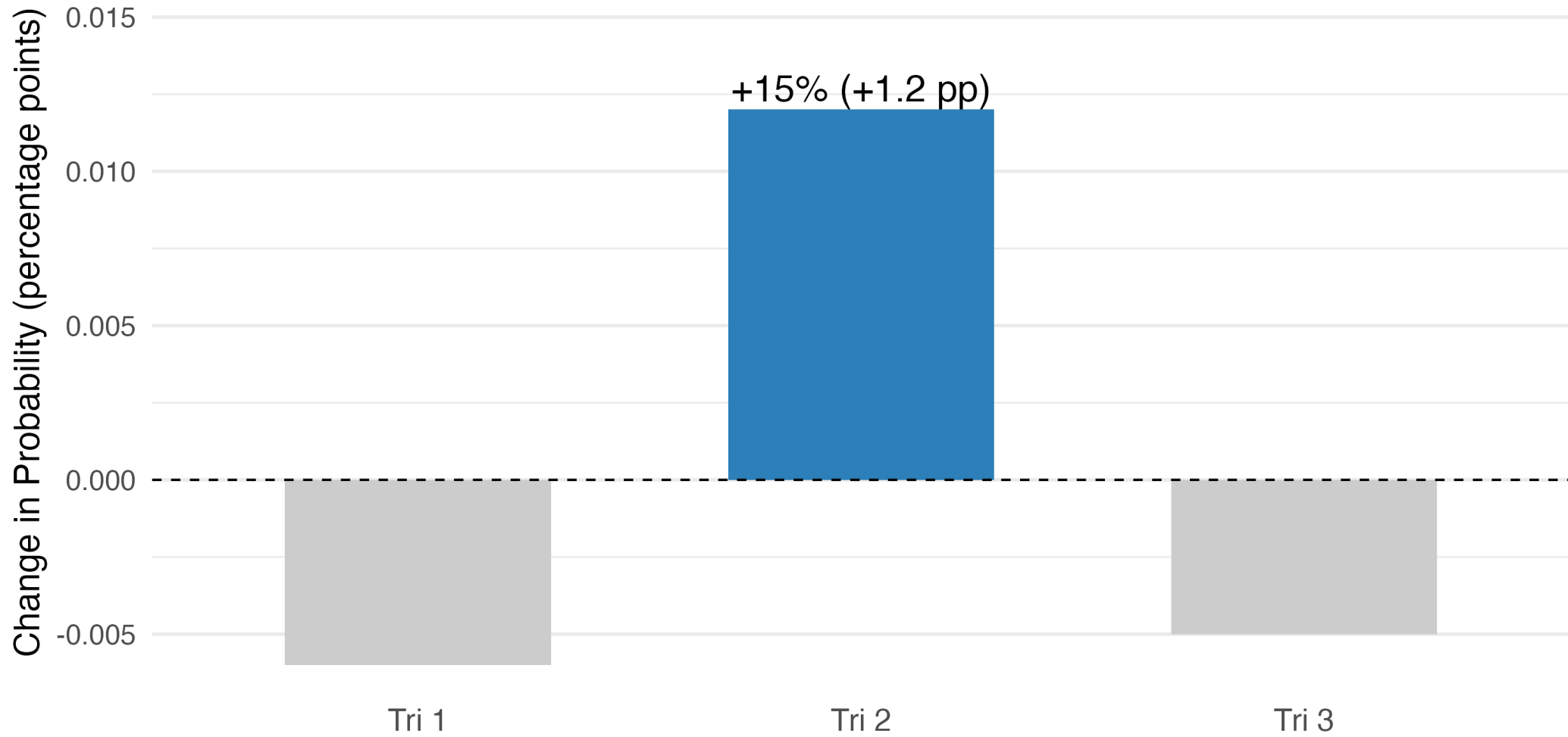


Nitrate <
5mg/L

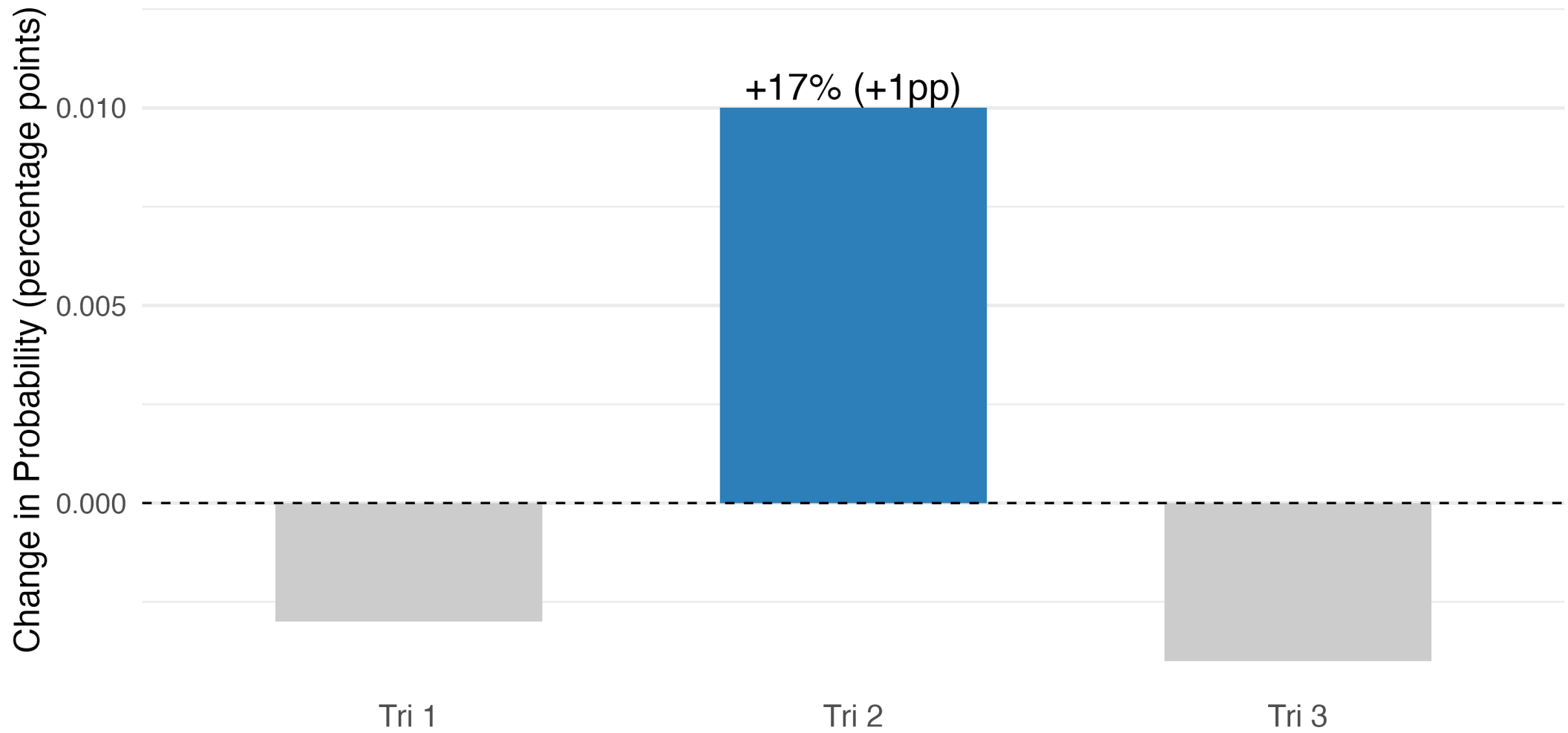


Effect of Nitrate Exposure (5–10 mg/L) on Preterm Birth

by Trimester

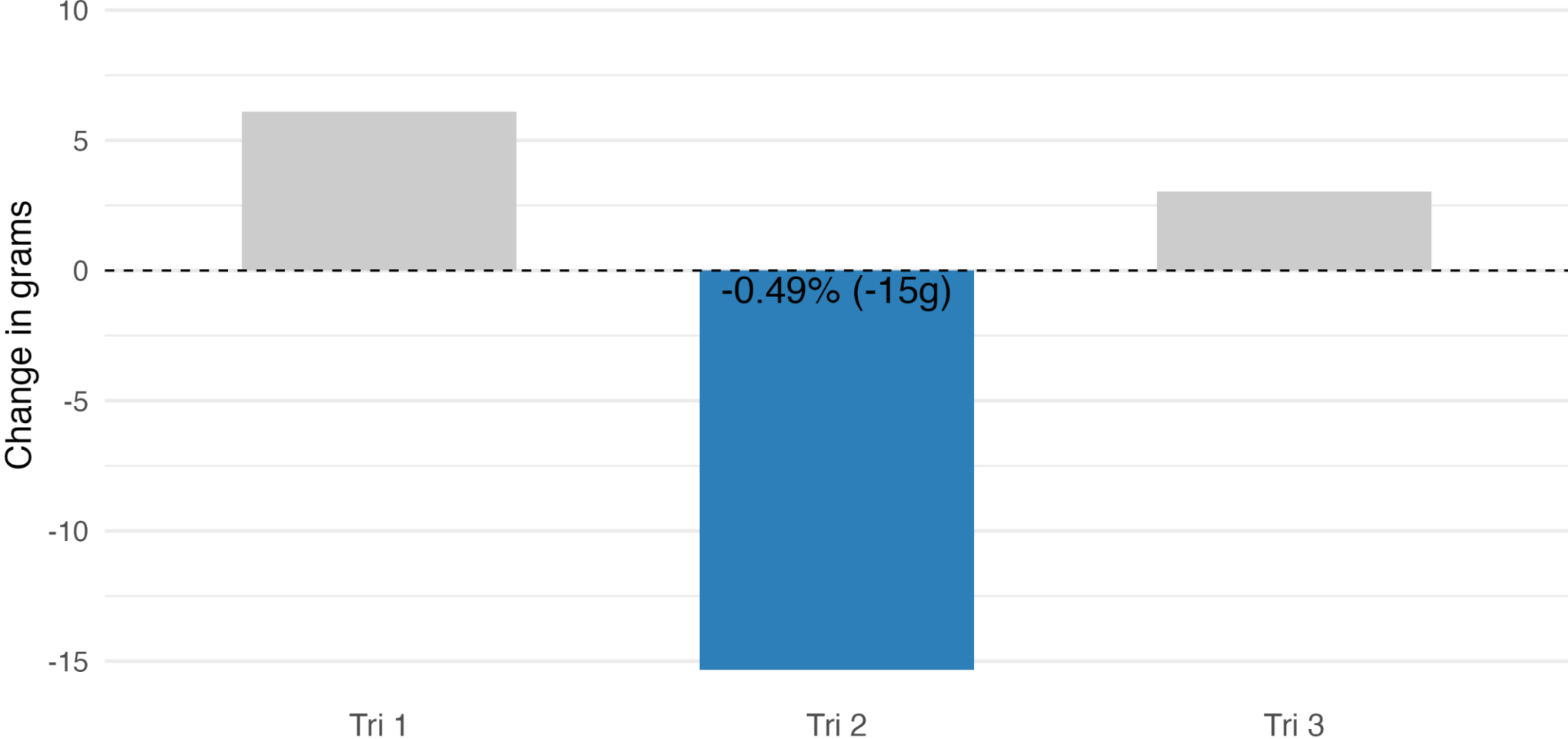


Effect of Nitrate Exposure (5–10 mg/L) on Low Birth Weight Birth by Trimester



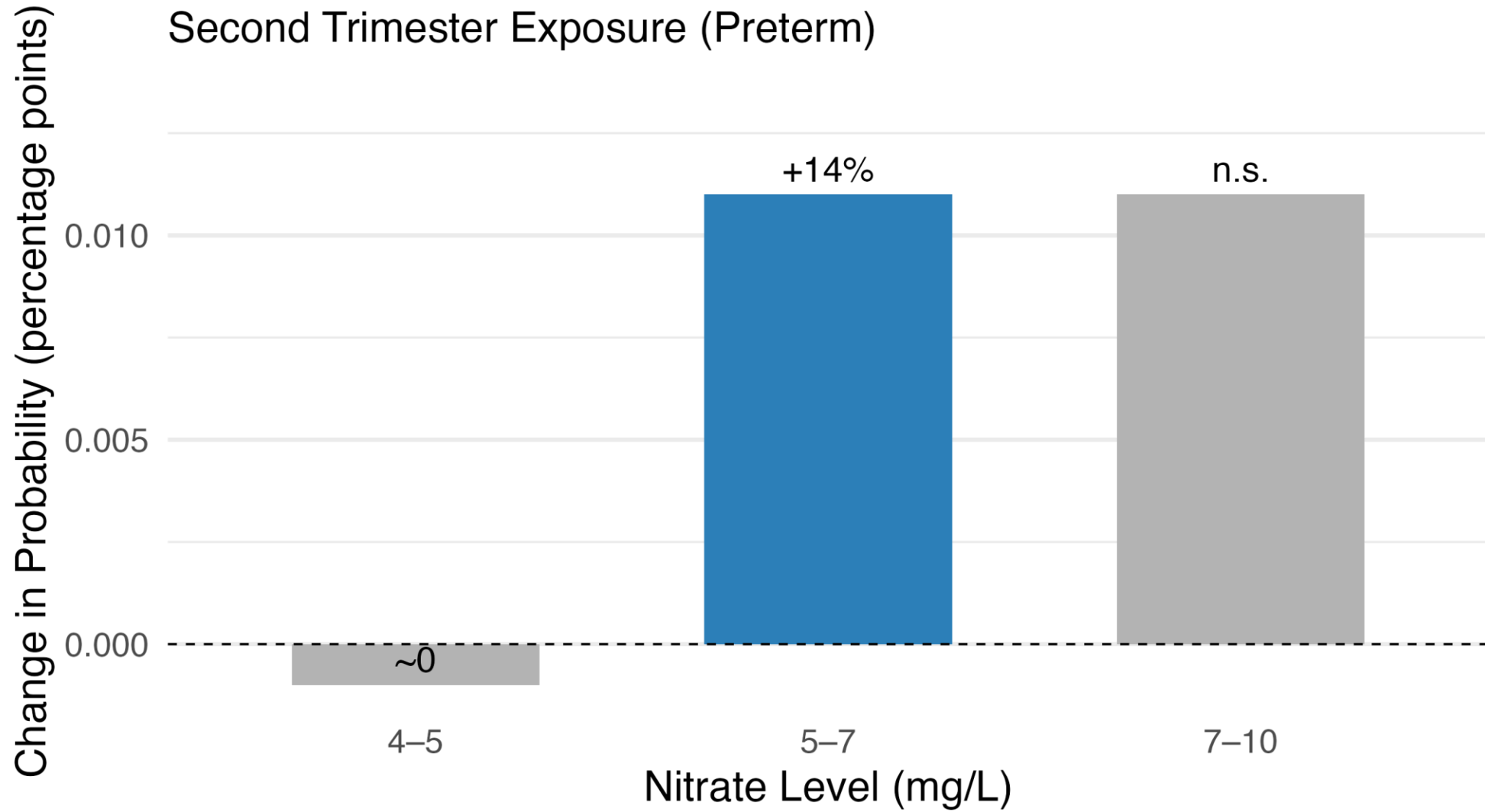
Effect of Nitrate Exposure (5–10 mg/L) on Birth Weight

by Trimester



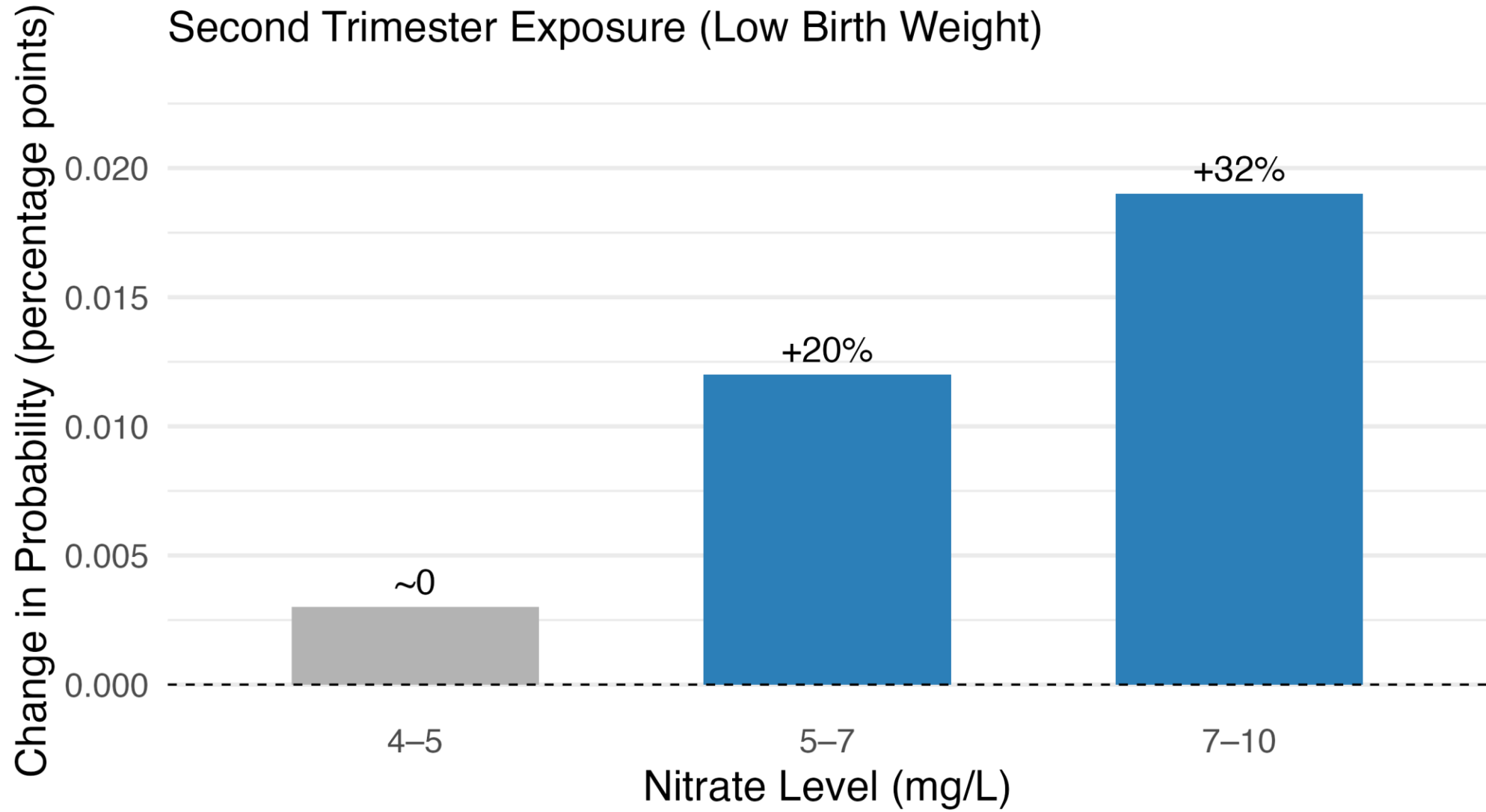
Risk Emerges Above 5 mg/L

Second Trimester Exposure (Preterm)



Risk Emerges Above 5 mg/L

Second Trimester Exposure (Low Birth Weight)



IMPLICATIONS FOR RISK-BASED REGULATION

- Regulatory compliant nitrate levels → increased risk of adverse birth outcomes
 - economically meaningful costs

Should the standard be reduced?

FROM EVIDENCE TO REGULATION

- What we measure—and how we measure it—shapes how we define “safe”
- Measuring these effects requires:
 - Careful research design
 - High-quality data

THANK YOU!

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