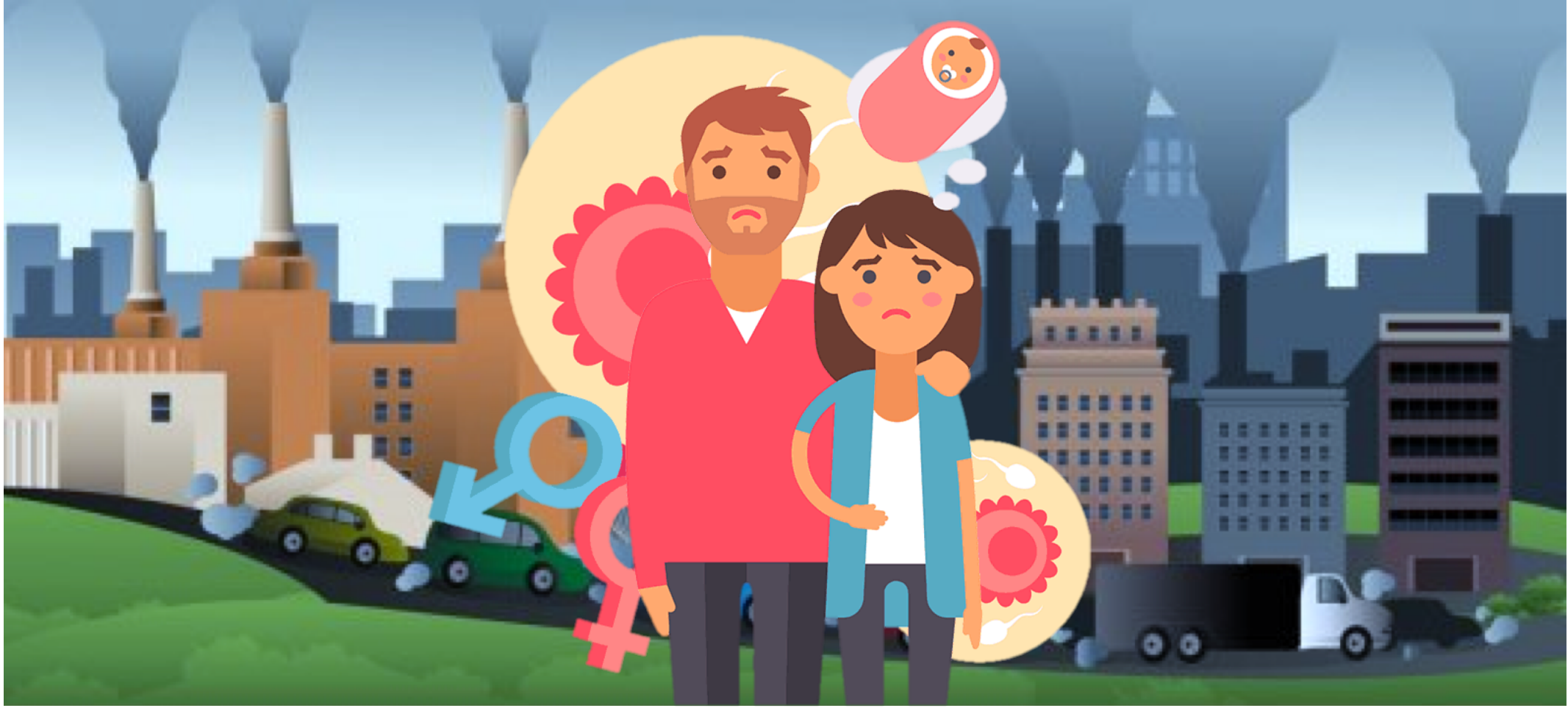
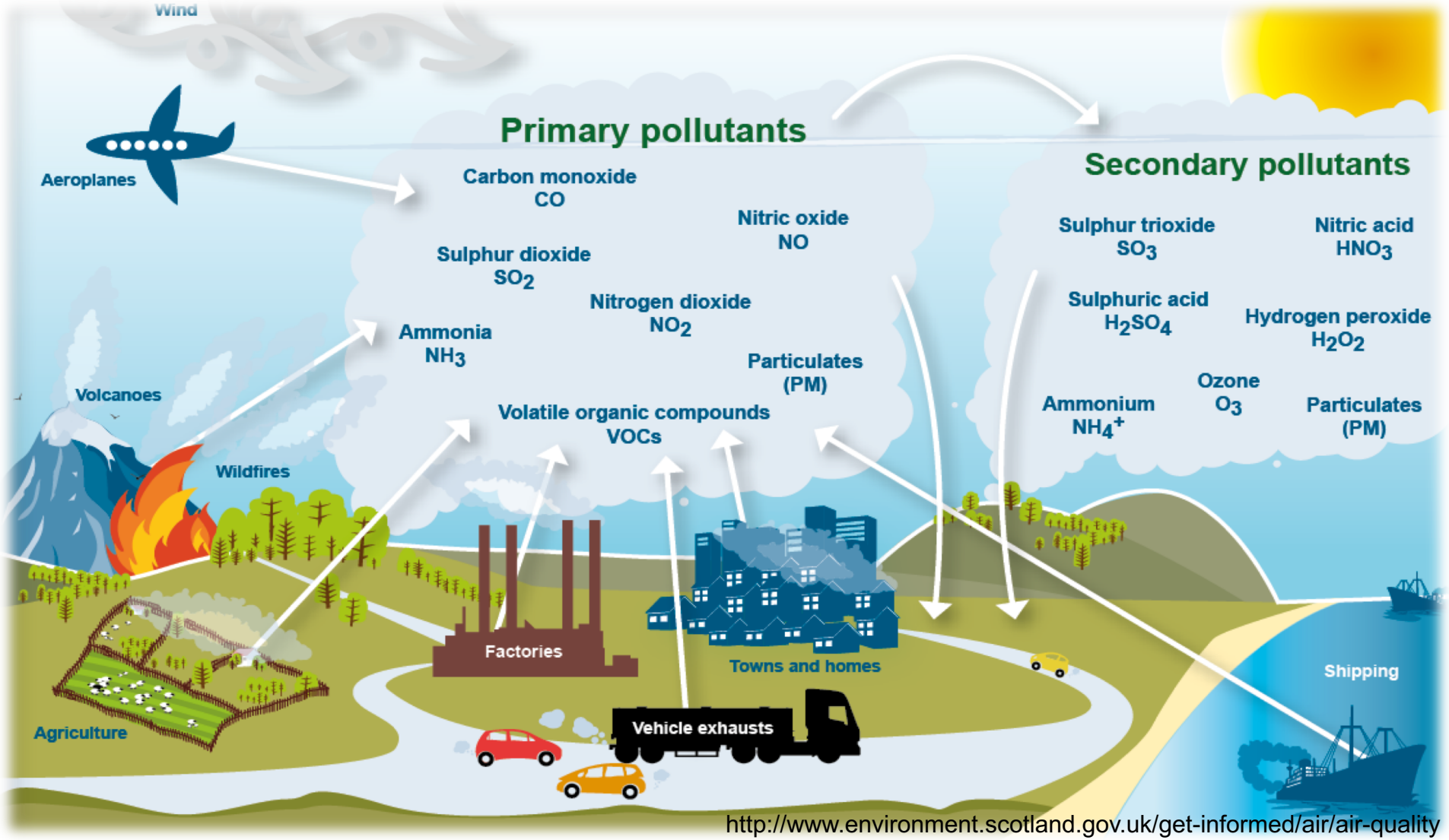


Traffic-related air pollution, folic acid, and female fertility

Audrey Gaskins, Sc.D.

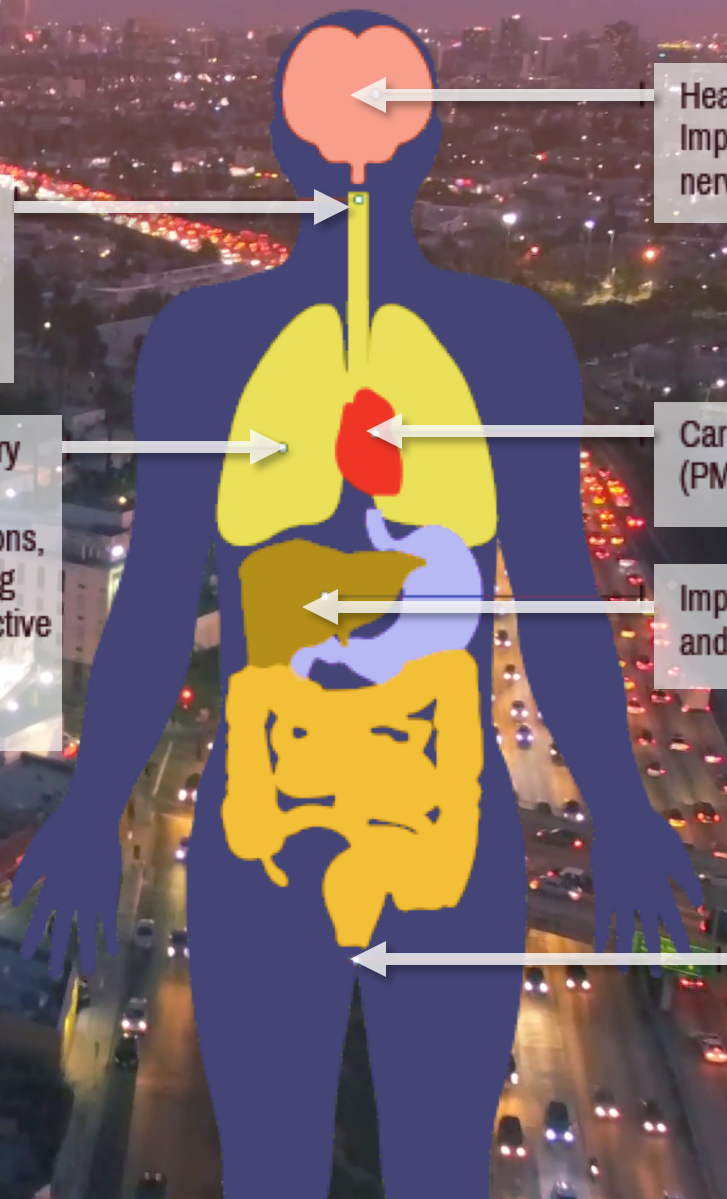
Assistant Professor
Department of Epidemiology
Emory Rollins School of Public Health

Sources of Air Pollution



http://www.environment.scotland.gov.uk/get-informed/air/air-quality

HEALTH EFFECTS OF AIR POLLUTION



Headache and anxiety (SO_2)
Impacts on the central nervous system (PM)

Irritation of eyes, nose, and throat;
Breathing Problems (O_3, PM, NO_2, SO_2, BaP)

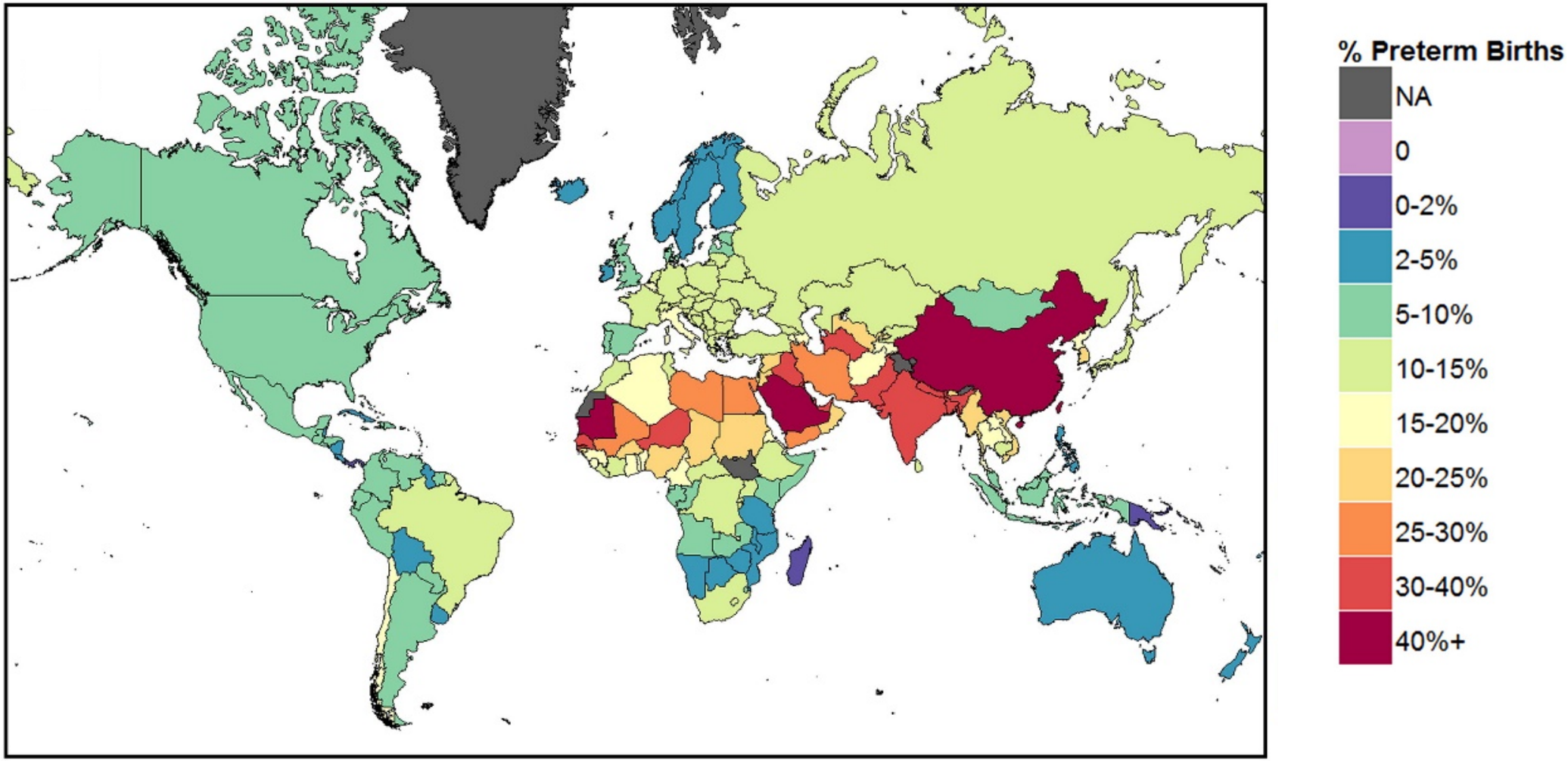
Cardiovascular diseases (PM, O_3, SO_2)

Impacts on the respiratory system: Irritation, inflammation and infections, Asthma and reduced lung function; Chronic obstructive pulminary disease (PM); Lung Cancer (PM, BaP)

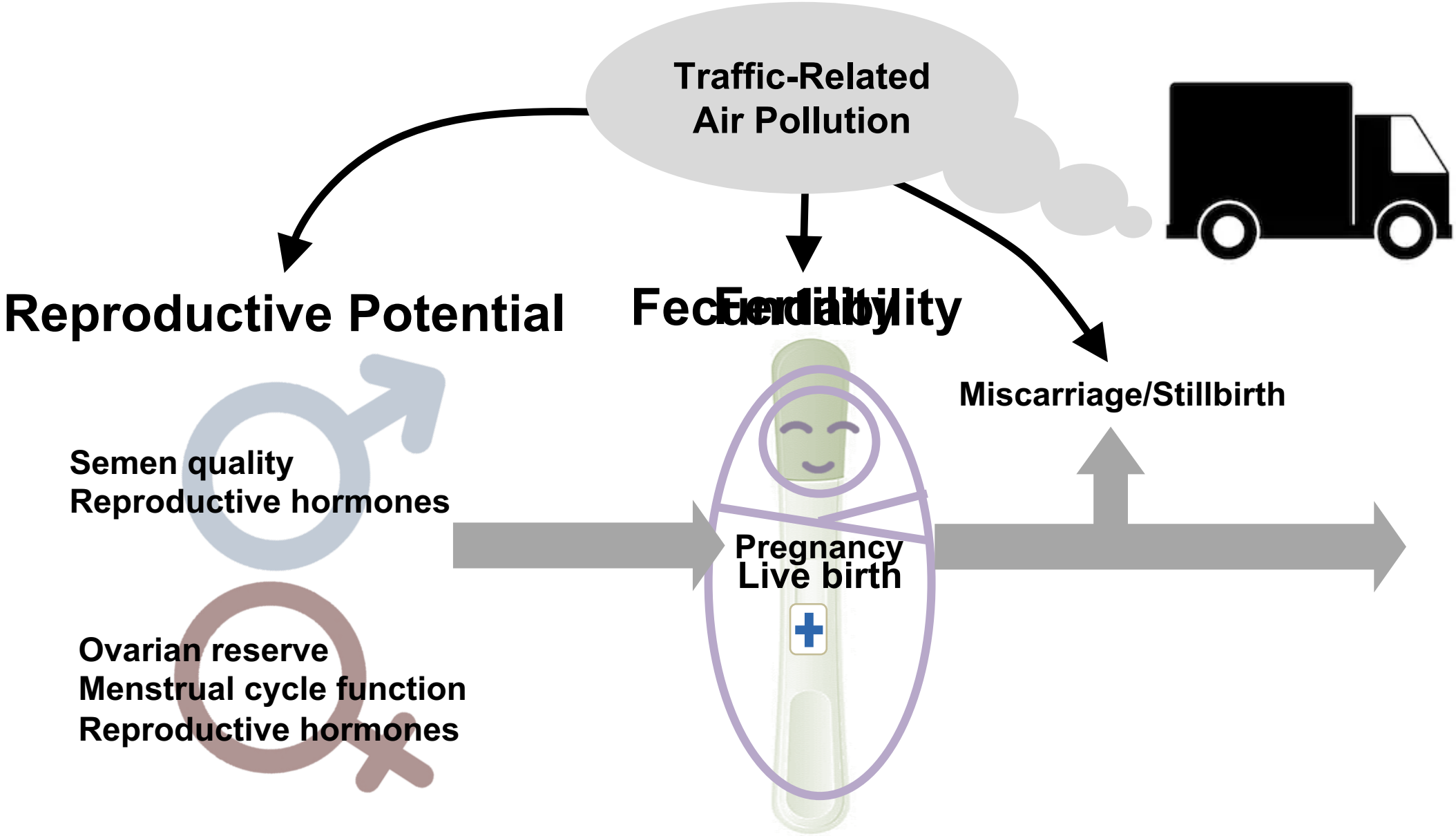
Impacts on liver, spleen and blood (NO_2)

Impacts on the reproductive system (PM)

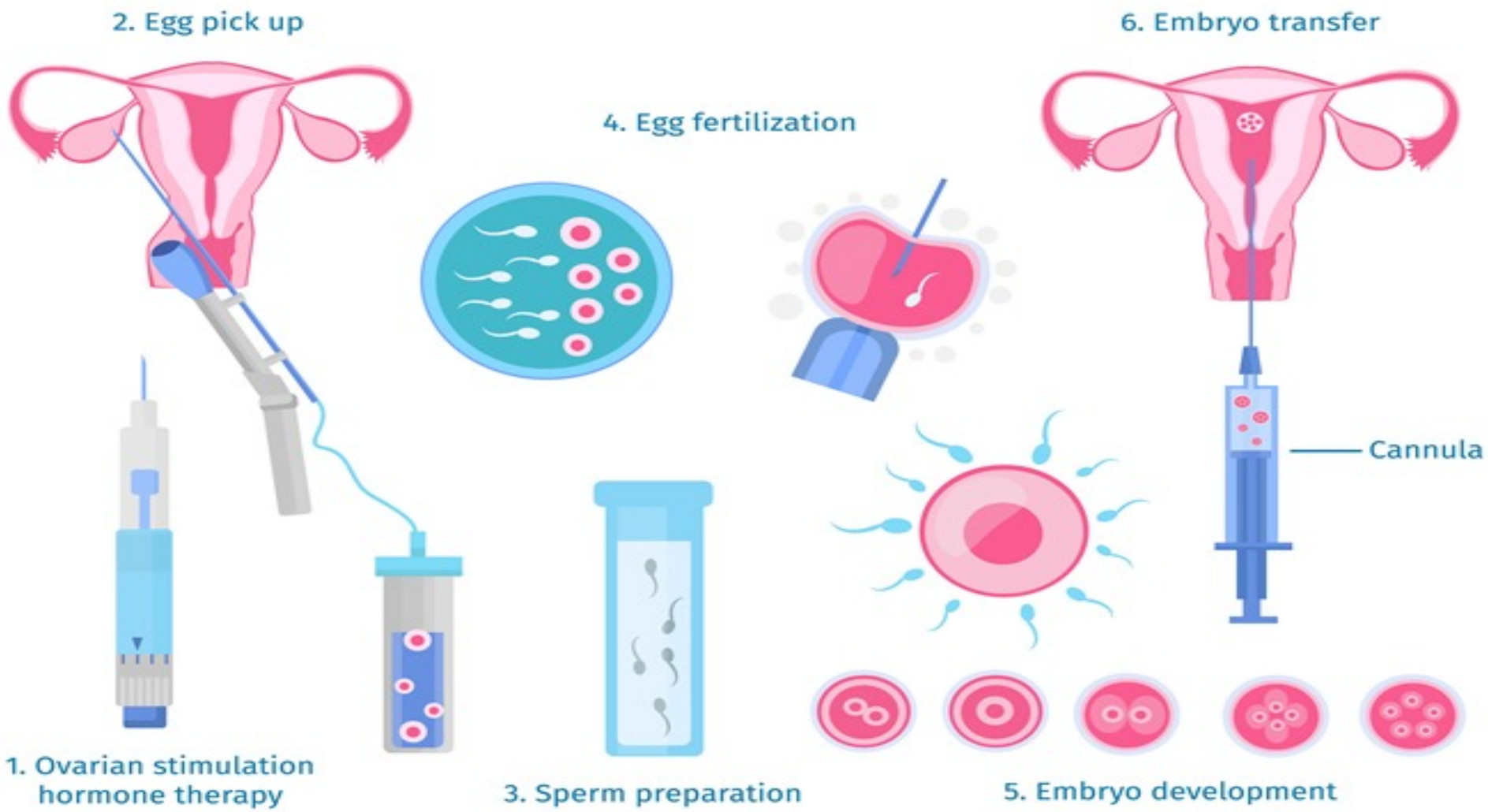
Percentage of Preterm Births Associated with Ambient $PM_{2.5}$ in 2010



Malley et al. Env Int 2017


Traffic-Related
Air Pollution
Reproductive Potential
Fecundability
Fertility
Miscarriage/Stillbirth
Semen quality
Reproductive hormones
Ovarian reserve
Menstrual cycle function
Reproductive hormones
Pregnancy
Live birth

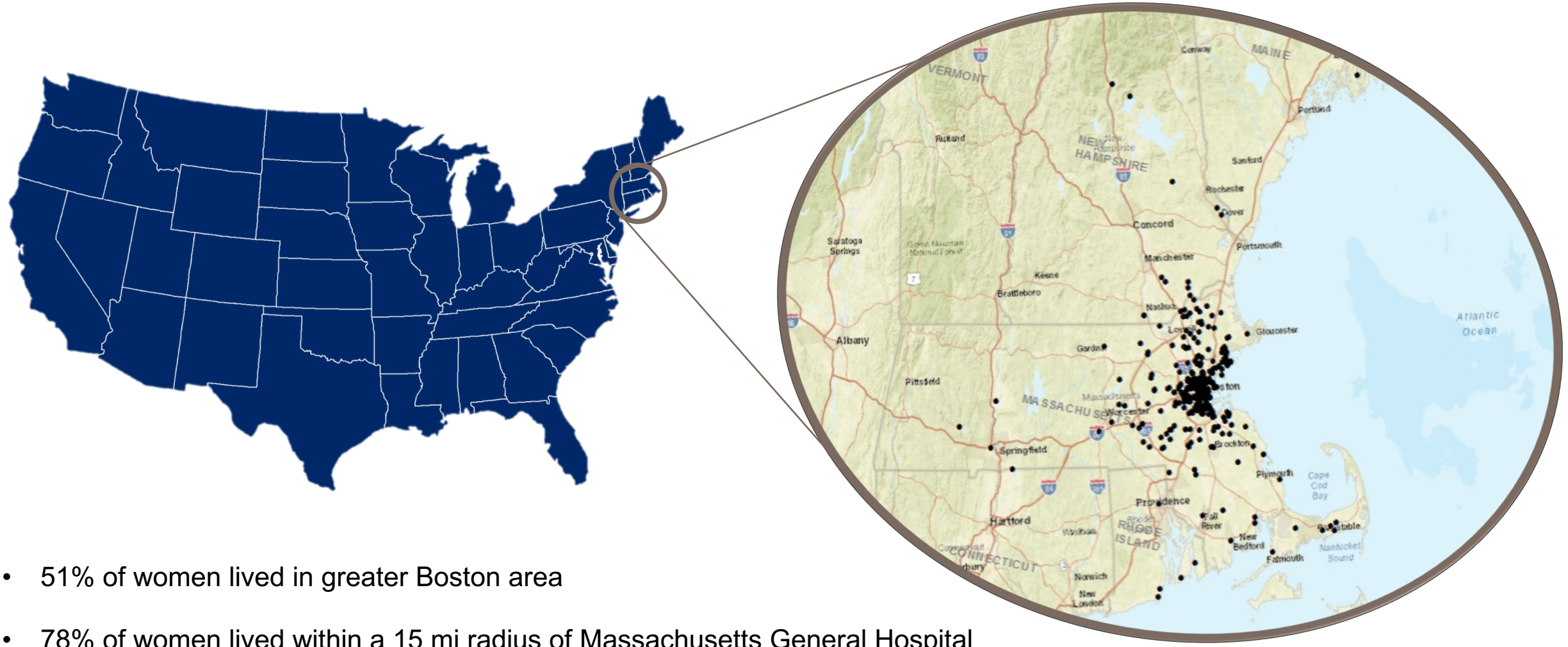
Assisted Reproductive Technologies (ART)



The EARTH Study

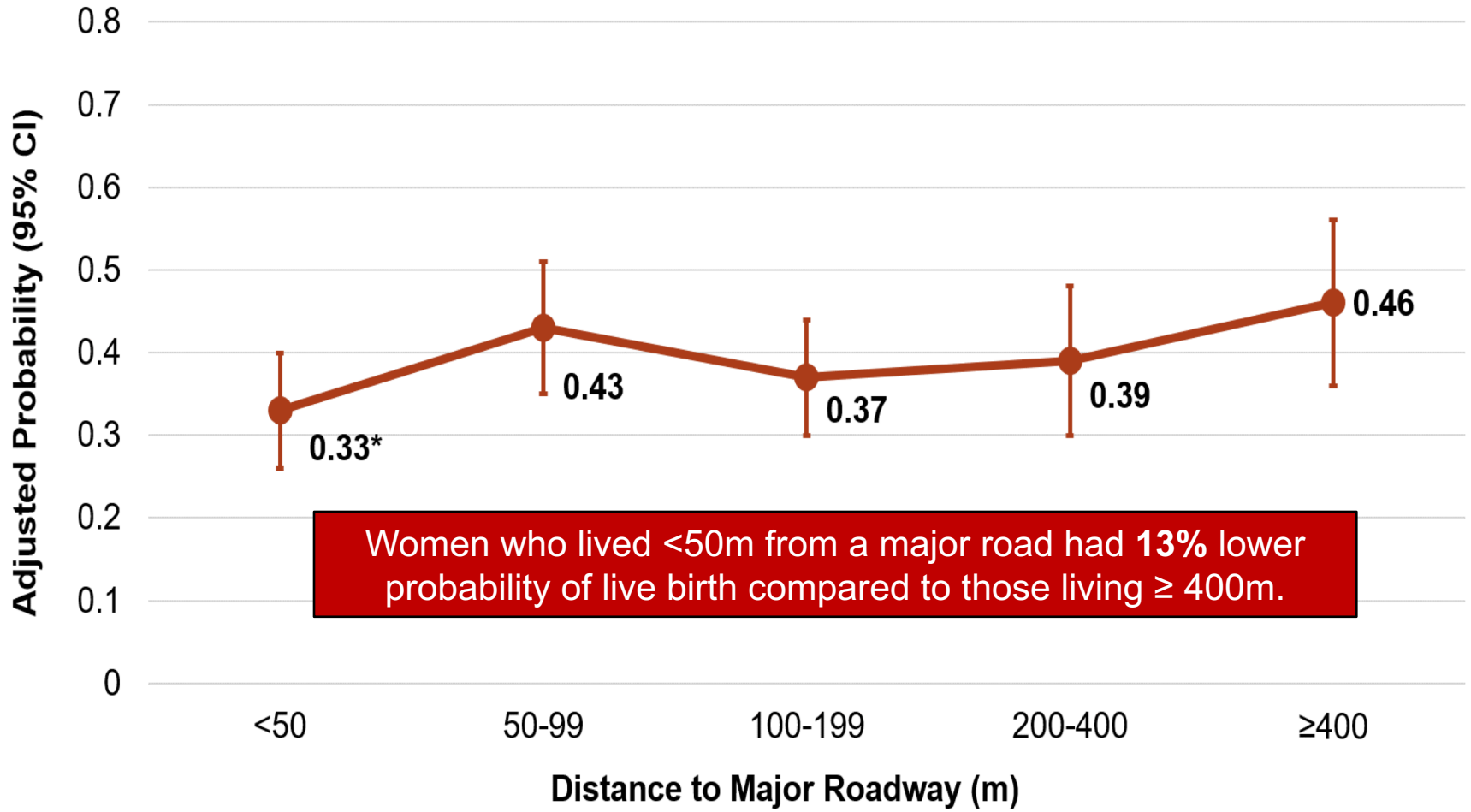
- Couples presenting at MGH Fertility Center (2004-2019)
  - Females: 18 to 45 yrs
  - Males: 18 to 55 yrs
- Extensive lifestyle, medical, and reproductive history questionnaire
- Residential address is collected at enrollment
  - Linked to validated spatio-temporal models of air pollution
- Food frequency questionnaire
- The couples are followed for ≤6 ART cycles
  - All outcomes are abstracted from medical records by trained research nurses

Geographical Distribution of EARTH Women (n=345)



- 51% of women lived in greater Boston area
- 78% of women lived within a 15 mi radius of Massachusetts General Hospital

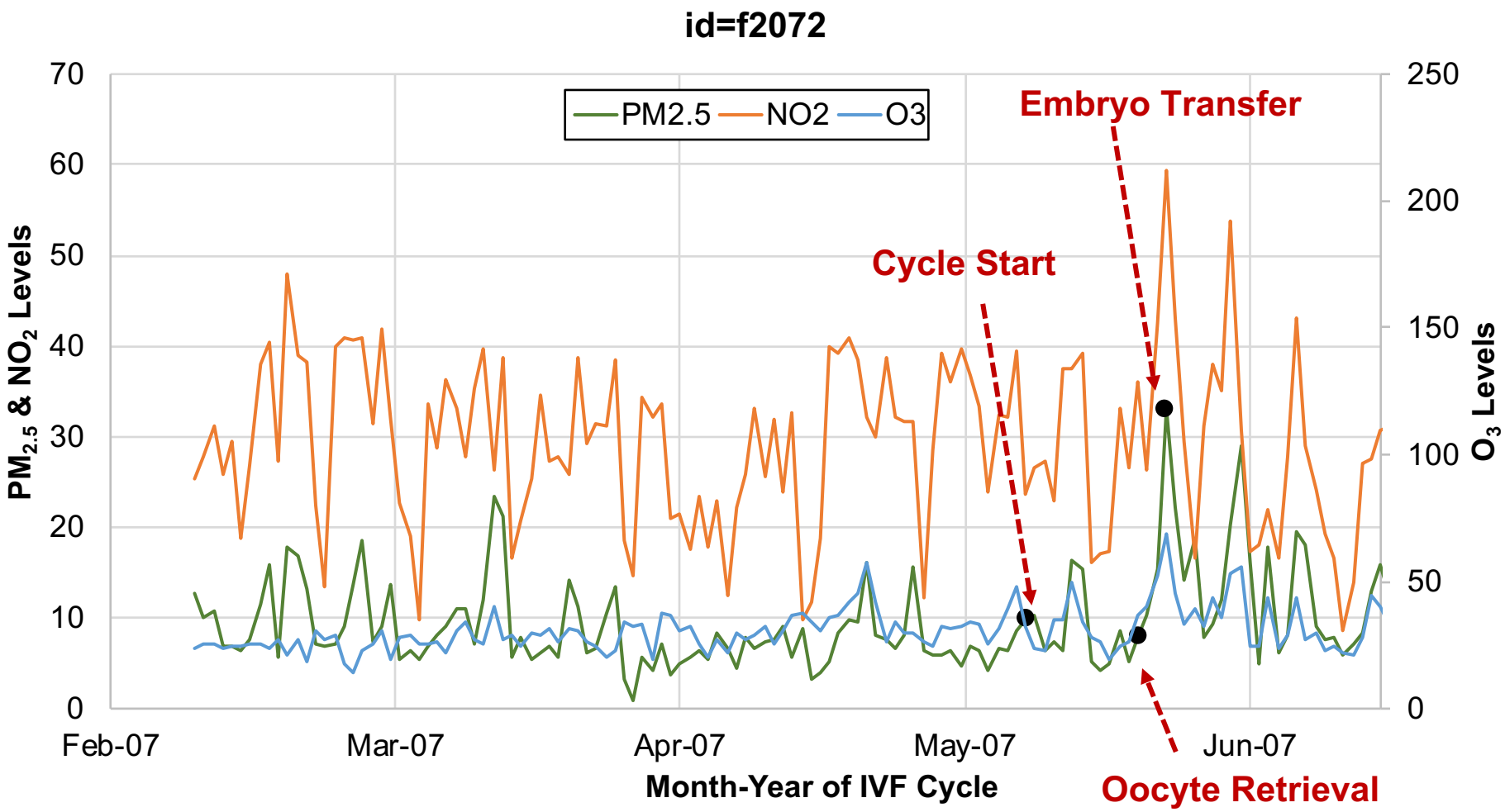
Distance to Major Roadway & Live Birth following ART



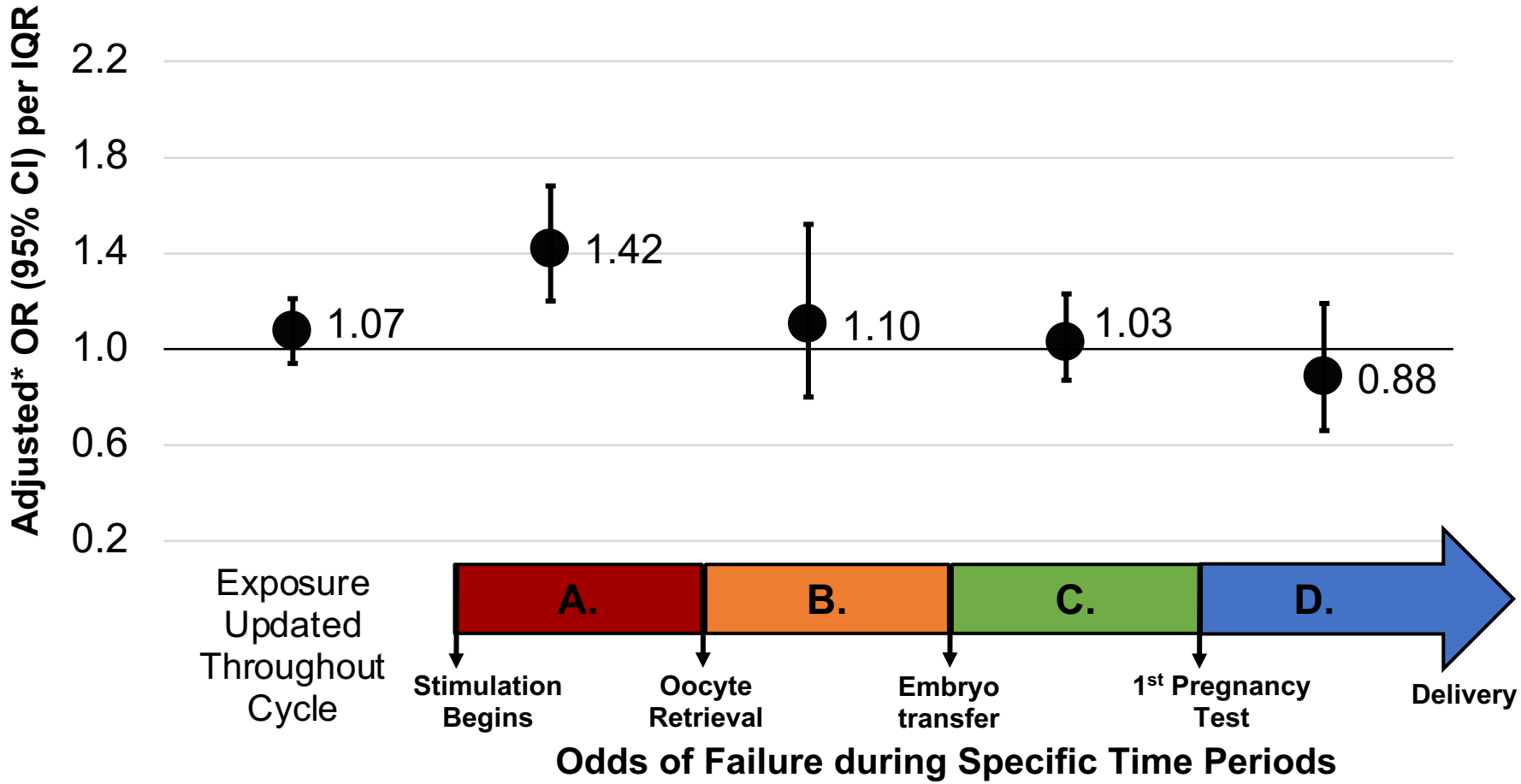
Adjusted for age, BMI, race, and smoking status, education level and census tract median income

Gaskins et al. Env Int 2018

Air Pollution Data for a Sample ART Cycle



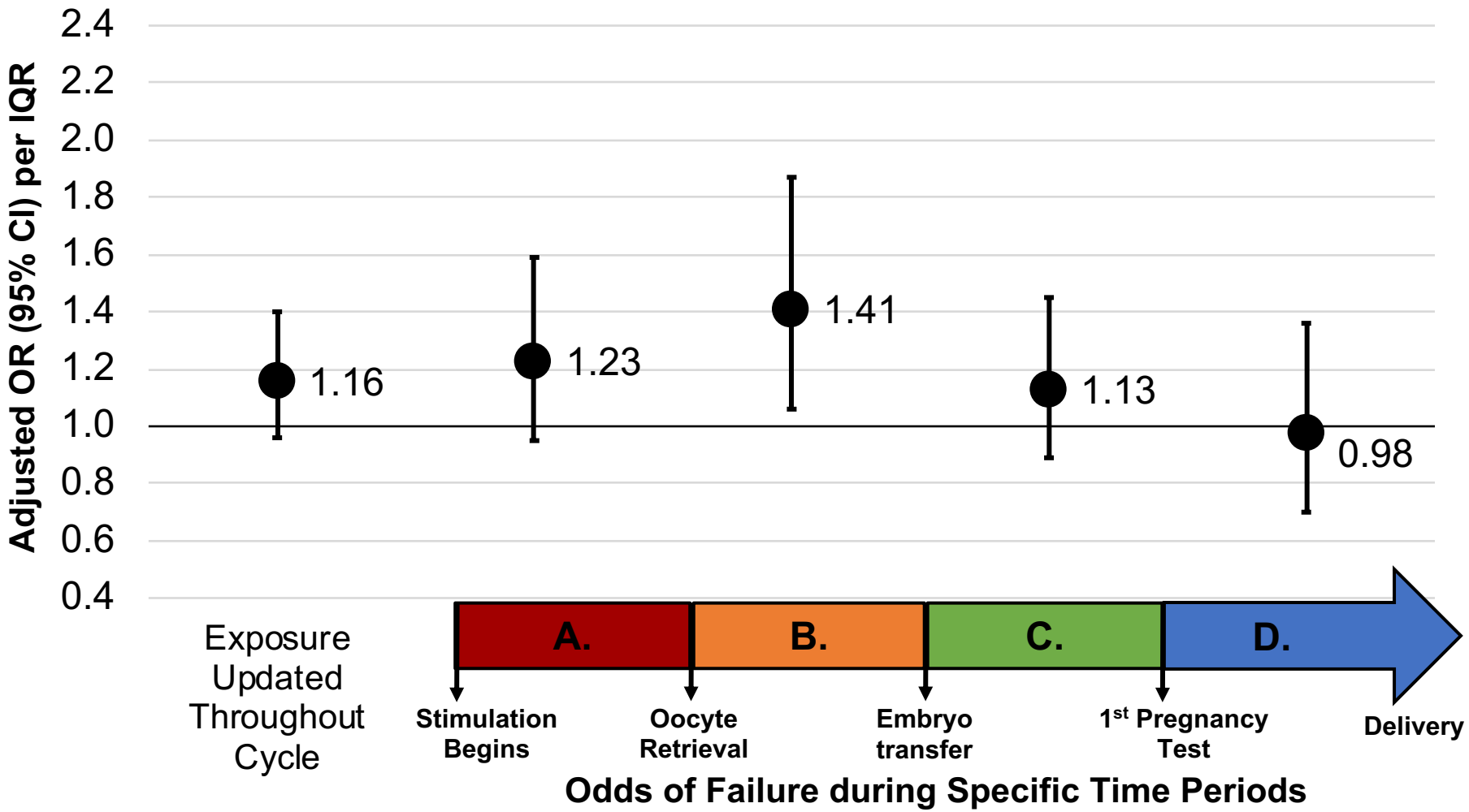
Nitrogen Dioxide (NO_2) and Odds of Failing ART



*Adjusted for age, BMI, smoking status, infertility diagnosis, temperature, and protocol

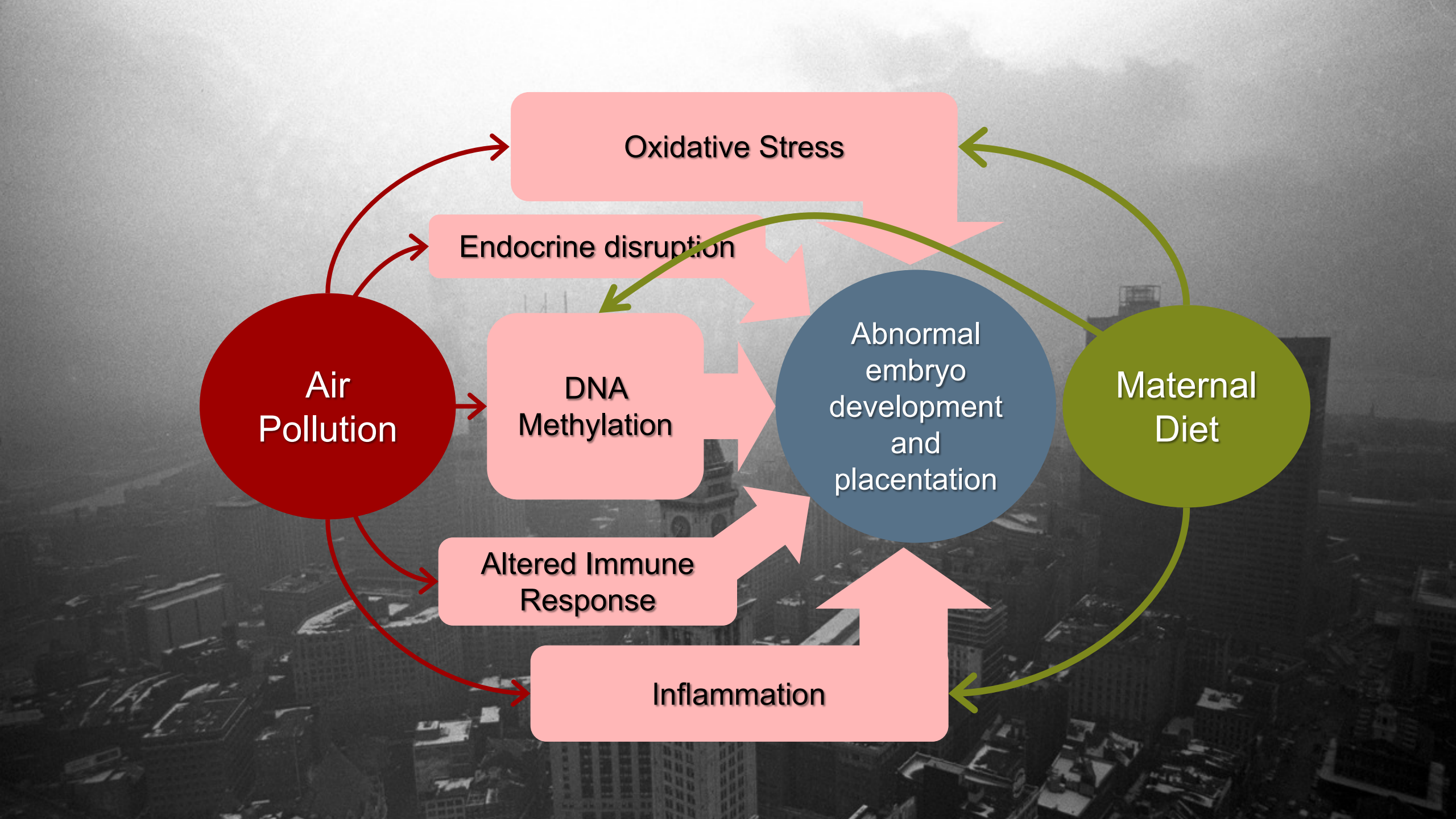
Gaskins et al. Environ Health Perspect 2019

Black Carbon and Odds of Failing IVF

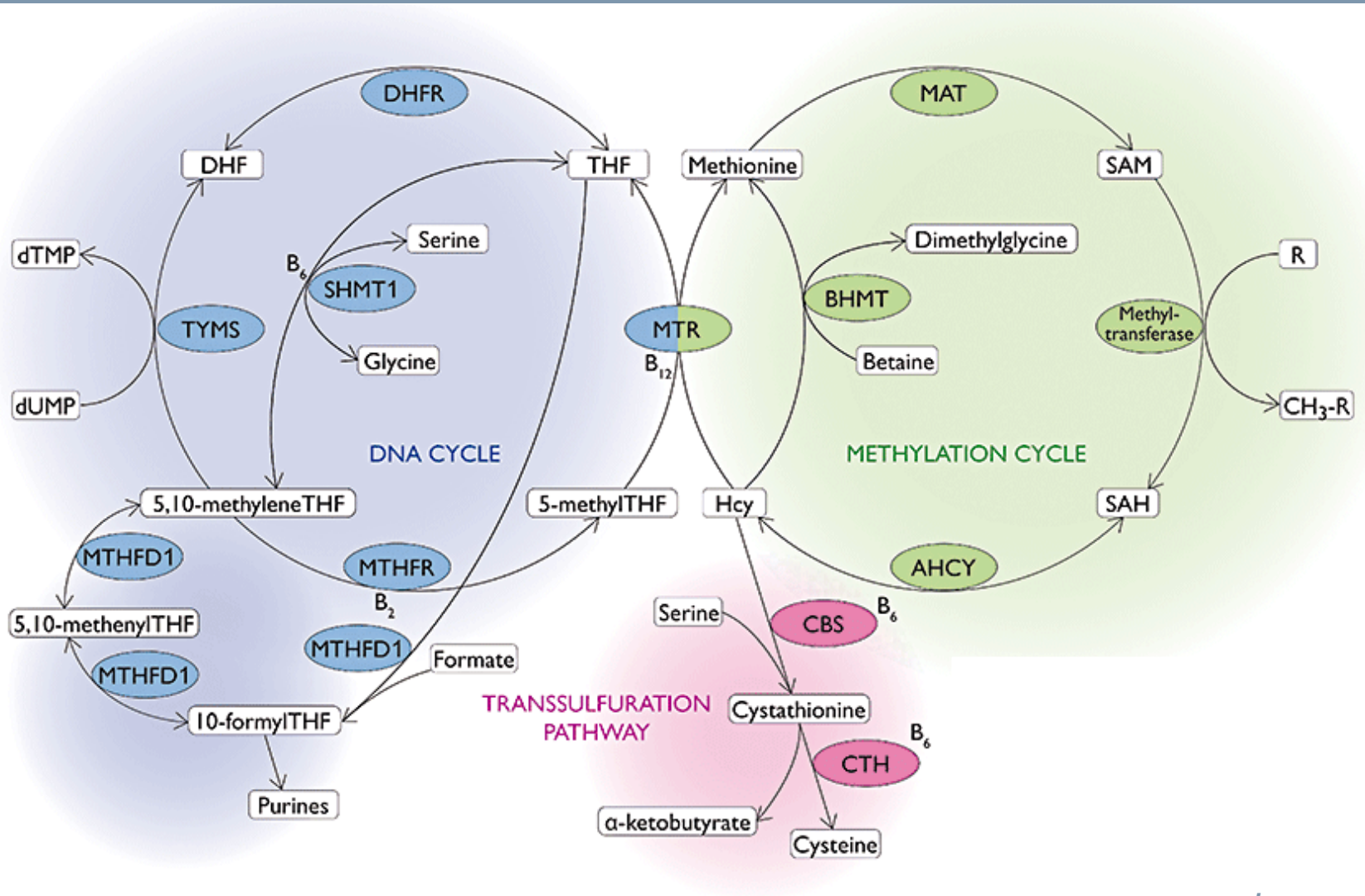


*Adjusted for age, BMI, smoking status, infertility diagnosis, temperature, and protocol

Gaskins et al. Environ Health Perspect 2019

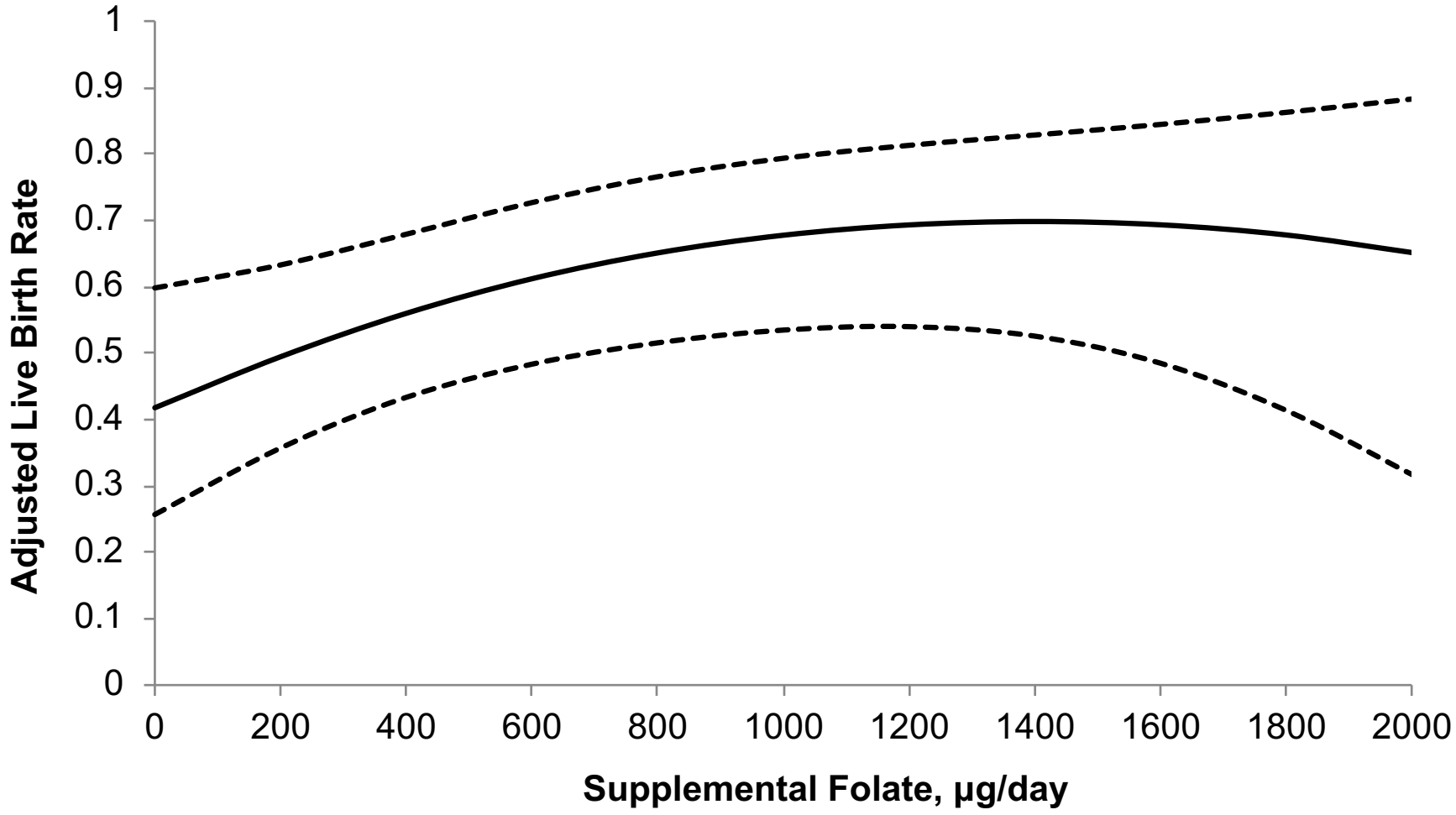

Oxidative Stress
Endocrine disruption
Air Pollution
DNA Methylation
Abnormal embryo development and placentation
Maternal Diet
Altered Immune Response
Inflammation

Folate and One-Carbon Metabolism



Laanpere et al. Nut Rev 2010

Supplemental Folate and Live Birth following ART



Gaskins et al. Obstet Gynecol 2014

B vitamins attenuate the epigenetic effects of ambient fine particles in a pilot human intervention trial

Jia Zhong[a,1], Oskar Karlsson[b,c], Guan Wang[d], Jun Li[e,f], Yichen Guo[g], Xinyi Lin[h], Michele Zemplenyi[g], Marco Sanchez-Guerra[i], Letizia Trevisi[j], Bruce Urch[k,l,m,n], Mary Speck[k], Liming Liang[g], Brent A. Coull[g], Petros Koutrakis[j], Frances Silverman[k,l,m,n], Diane R. Gold[j,o], Tangchun Wu[e,f], and Andrea A. Baccarelli[a]

[a]Mailman School of Public Health, Columbia University, New York, NY 10032; [b]Center for Molecular Medicine, Department of Clinical Neuroscience, Karolinska Institutet, 171 77 Stockholm, Sweden; [c]Department of Pharmaceutical Biosciences, Uppsala University, 752 37 Uppsala, Sweden; [d]Institute for Genomic Medicine, Columbia University, New York, NY 10032; [e]Department of Occupational and Environmental Health, Key Laboratory of Environment and Health, Ministry of Education and State Key Laboratory of Environmental Health (Incubating), School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei, China, 430030; [f]Department of Epidemiology and Biostatistics, School of Public Health,

RESEARCH ARTICLE

Joint Effects of Prenatal Air Pollutant Exposure and Maternal Folic Acid Supplementation on Risk of Autism Spectrum Disorder

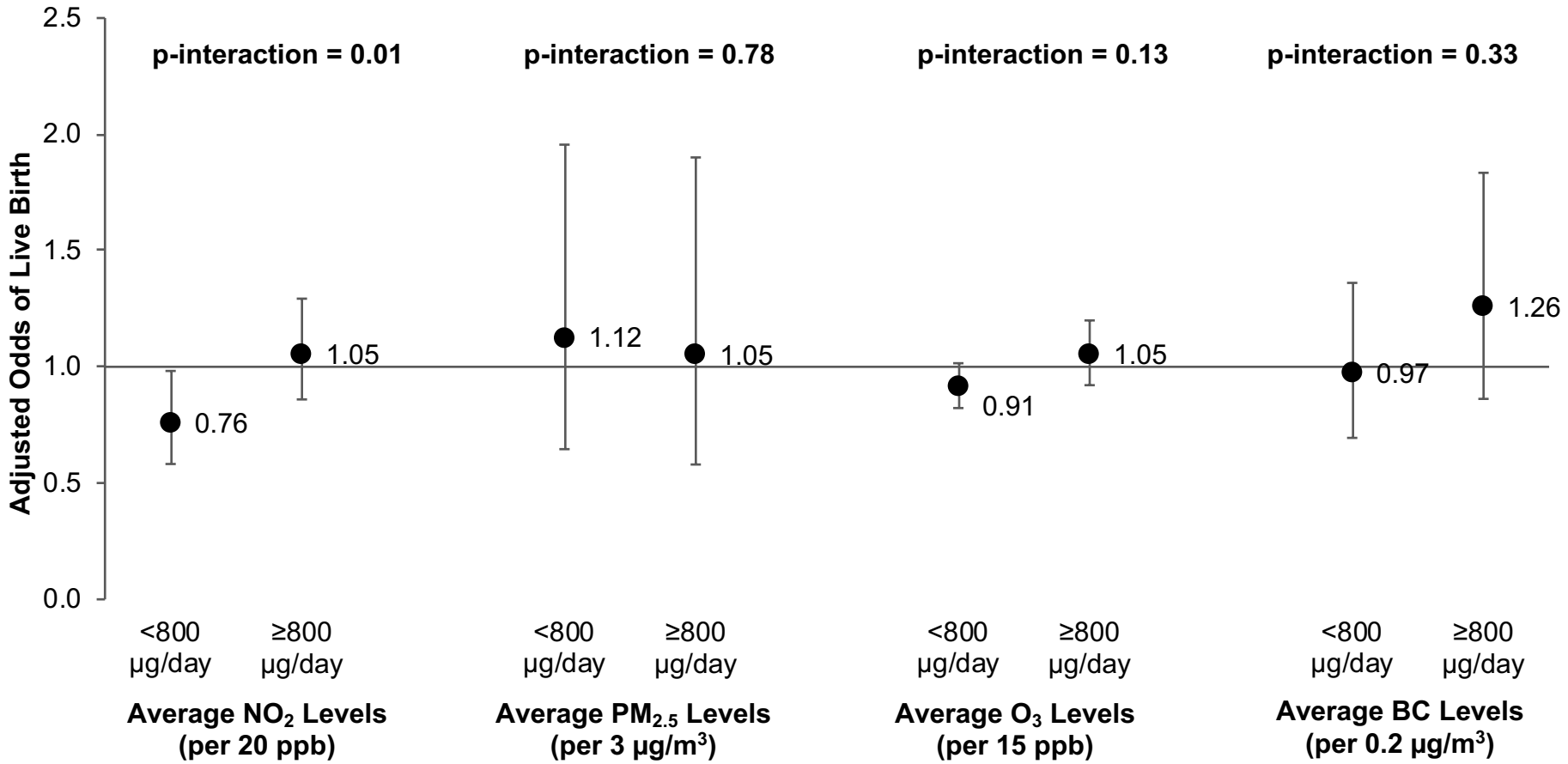
Amanda J. Goodrich, Heather E. Volk, Daniel J. Tancredi, Rob McConnell, Fred W. Lurmann, Robin L. Hansen, and Rebecca J. Schmidt

Original Contribution

Maternal Exposure to Nitrogen Dioxide, Intake of Methyl Nutrients, and Congenital Heart Defects in Offspring

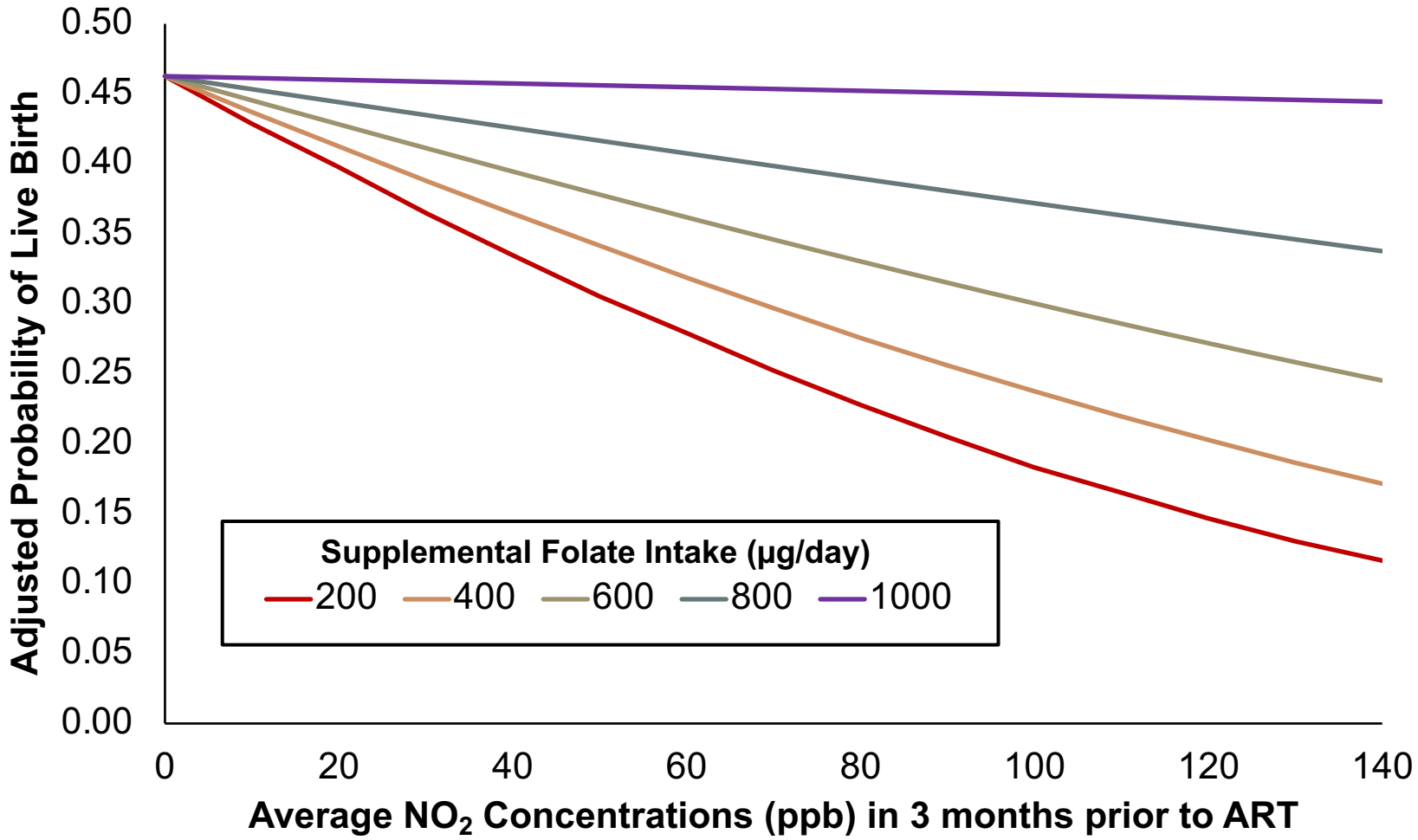
Jeanette A. Stingone*, Thomas J. Luben, Suzan L. Carmichael, Arthur S. Aylsworth, Lorenzo D. Botto, Adolfo Correa, Suzanne M. Gilboa, Peter H. Langlois, Wendy N. Nembhard, Jennifer Richmond-Bryant, Gary M. Shaw, and Andrew F. Olshan, for the National Birth Defects Prevention Study

Effect Modification of Air Pollution/Live Birth Association by Supplemental Folate (< or ≥800 µg/day)



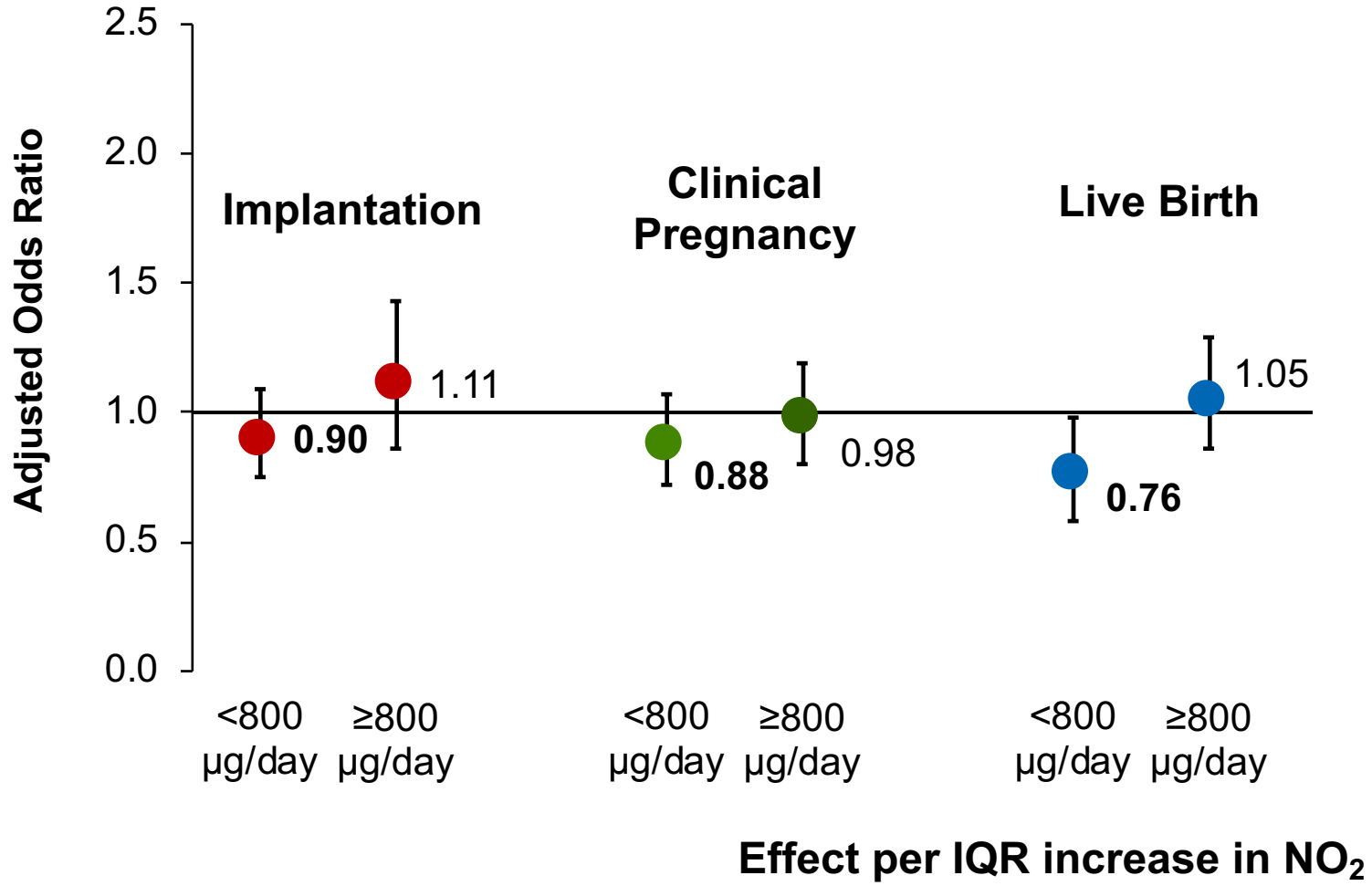
Gaskins et al. Am J Epidemiol 2019

Effect Modification of NO_2/Live Birth Association by Supplemental Folate (continuous)



Gaskins et al. Am J Epidemiol 2019

Effect Modification of Air Pollution/ART Outcomes by Supplemental Folate (< or ≥800 µg/day)



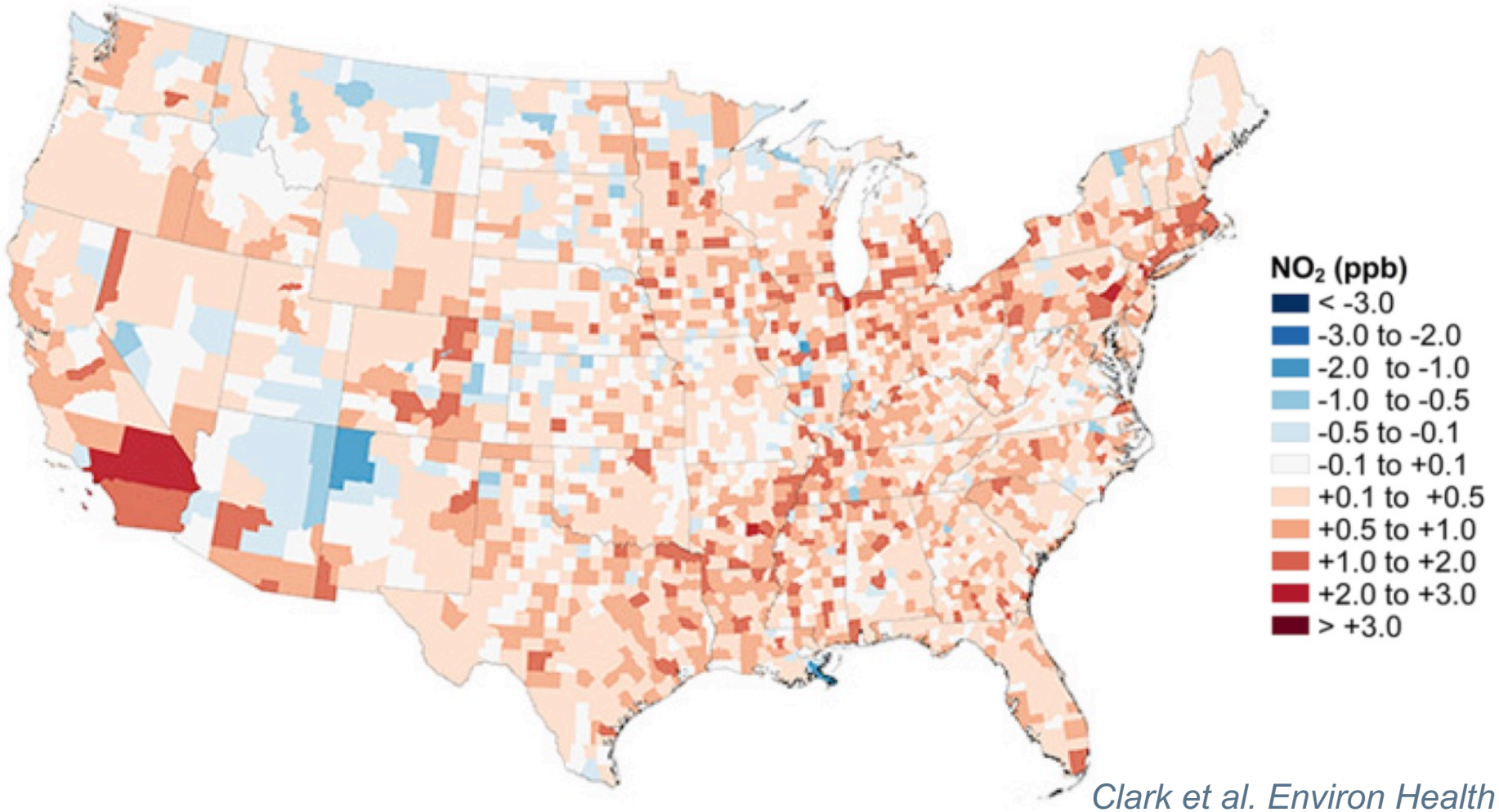
Gaskins et al. Am J Epidemiol 2019

Conclusions on Traffic-Related Air Pollution and Fertility

- Evidence continues to grow supporting a link between ambient air pollution and impaired fertility
  - Traffic-related combustion products may be the primary driver
  - Short-term exposures during critical windows may be particularly important
- Folate may offer protection against the negative reproductive consequences of air pollution
- Many lingering questions and areas for future research

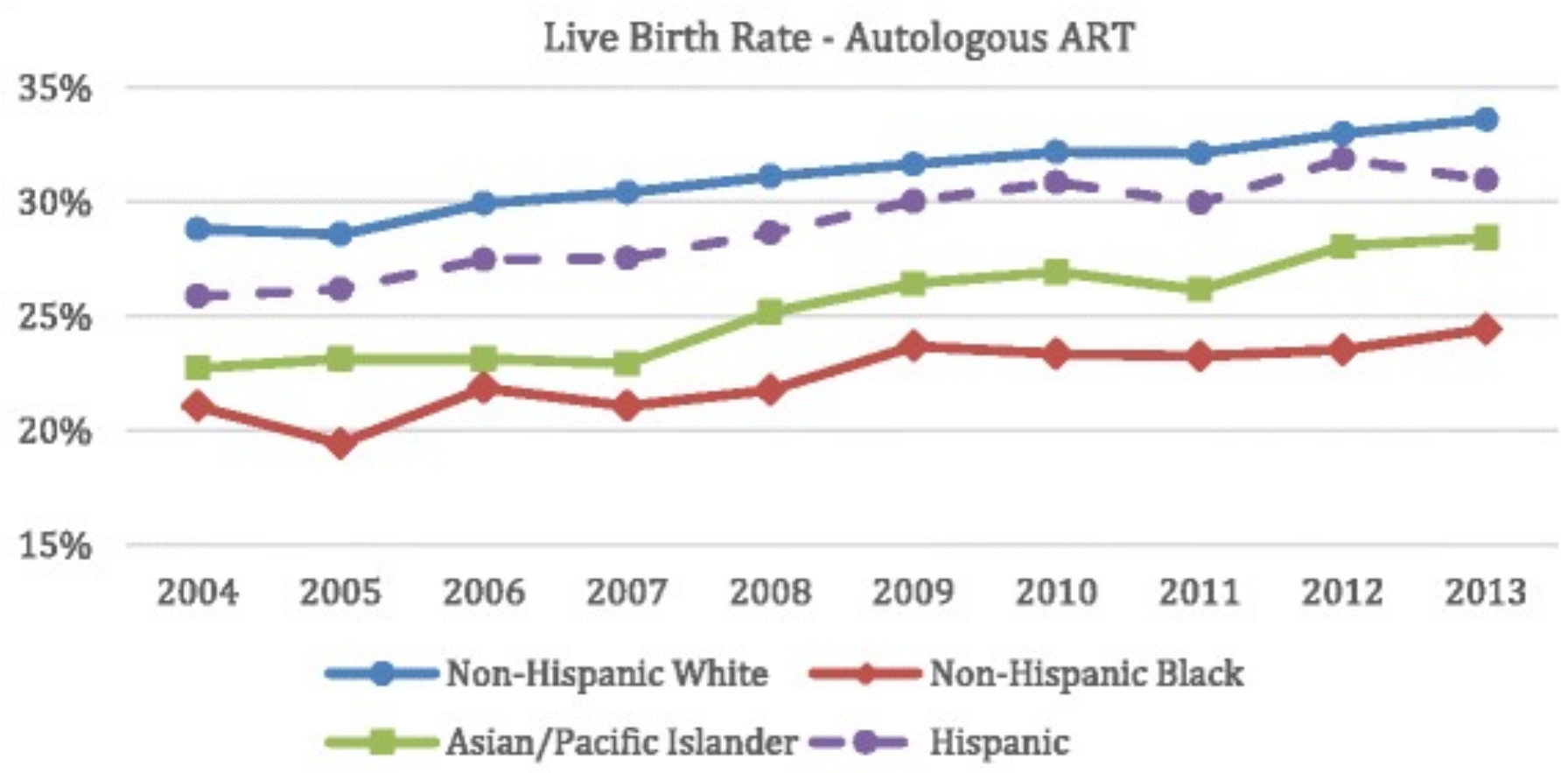
Racial Disparities in Traffic-Related Air Pollution Exposure

Absolute Difference in Mean NO_2 Concentrations between non-Whites and Whites in 2010



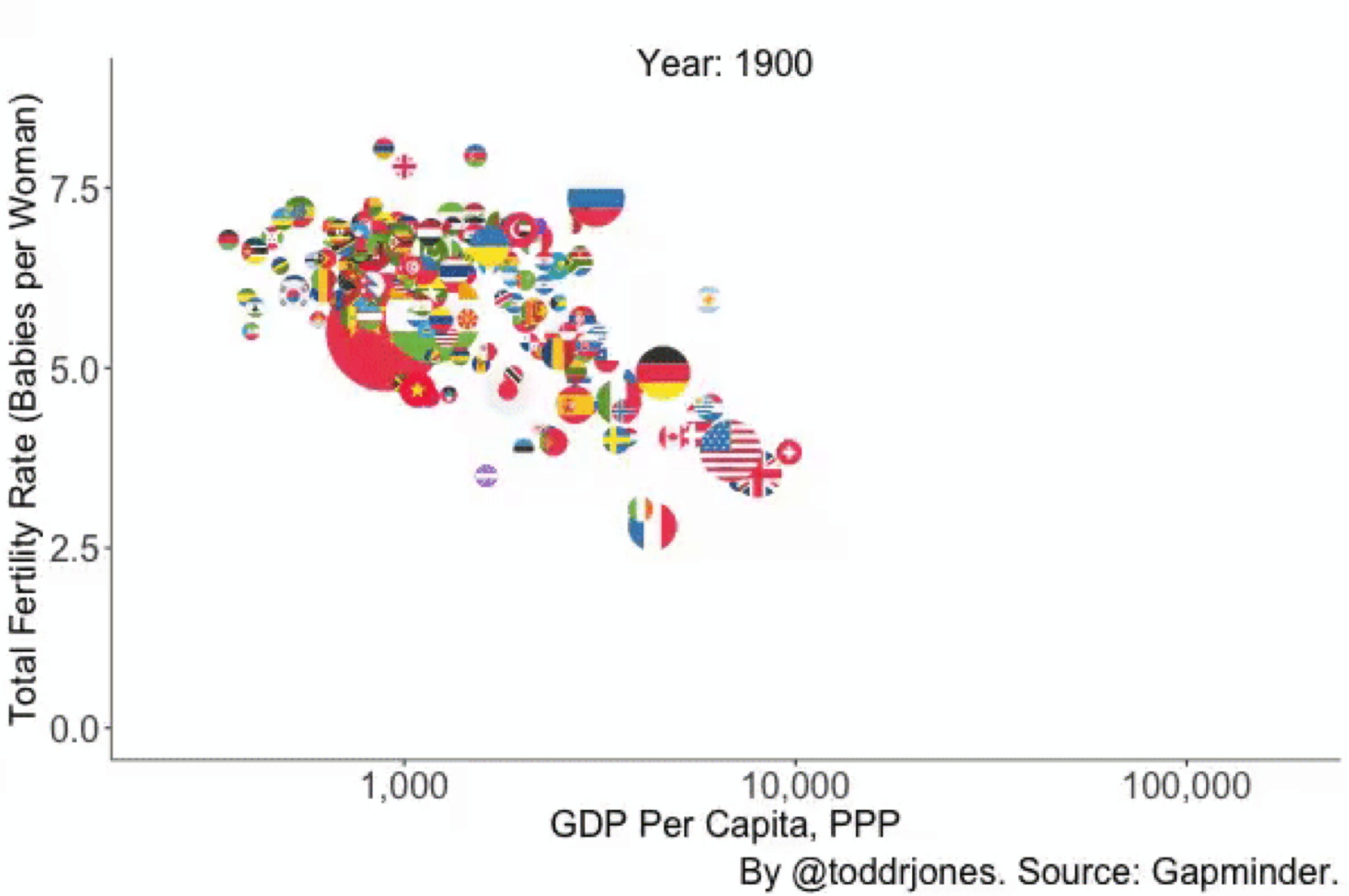
Clark et al. Environ Health Perspect 2017

Racial Disparities in ART Outcomes

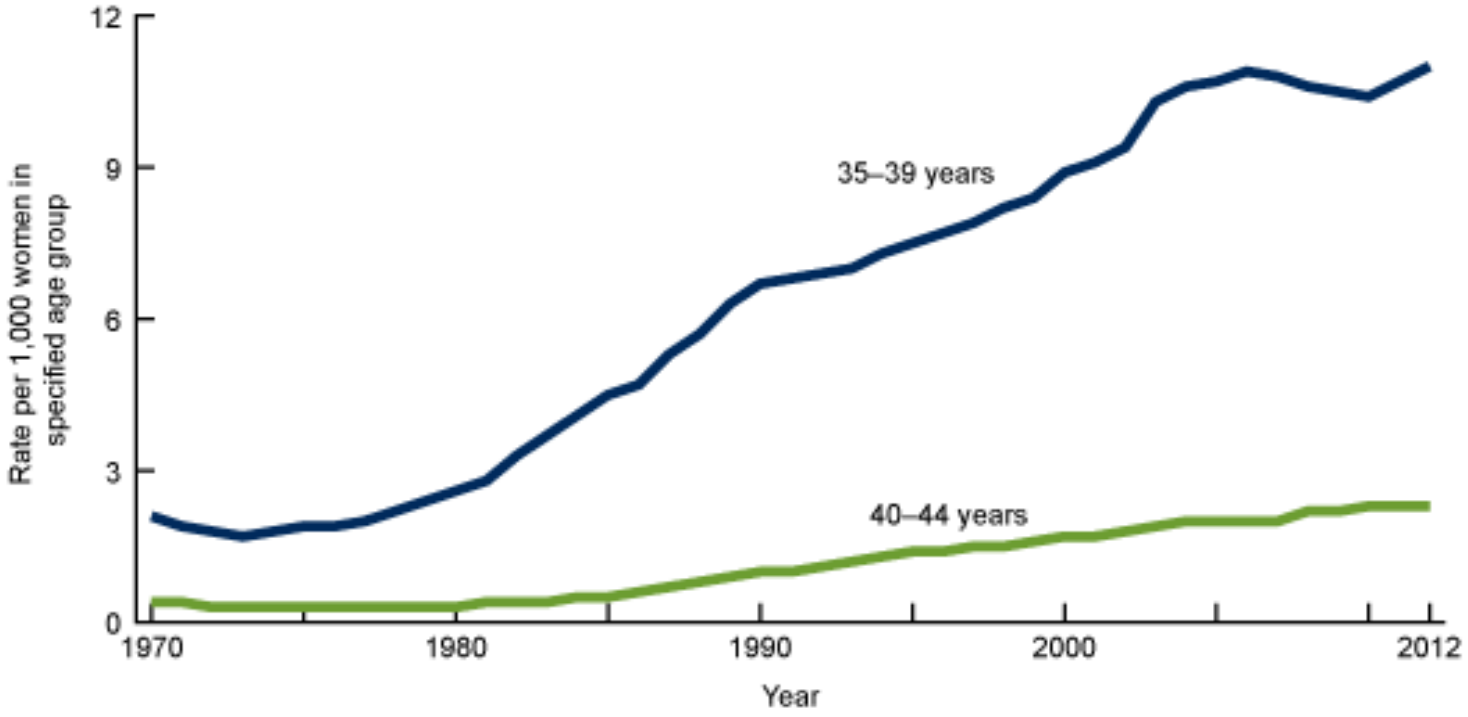


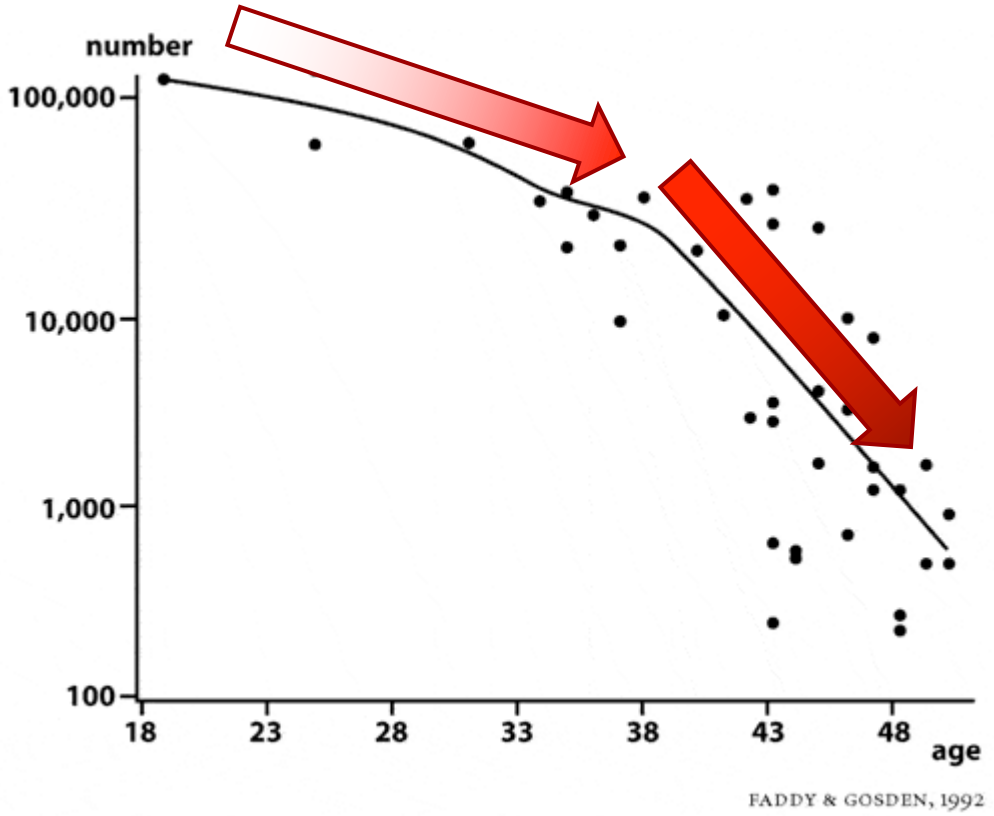
Shapiro et al. Reprod Biol Endocrinol 2017

Fertility Rates are Falling Worldwide



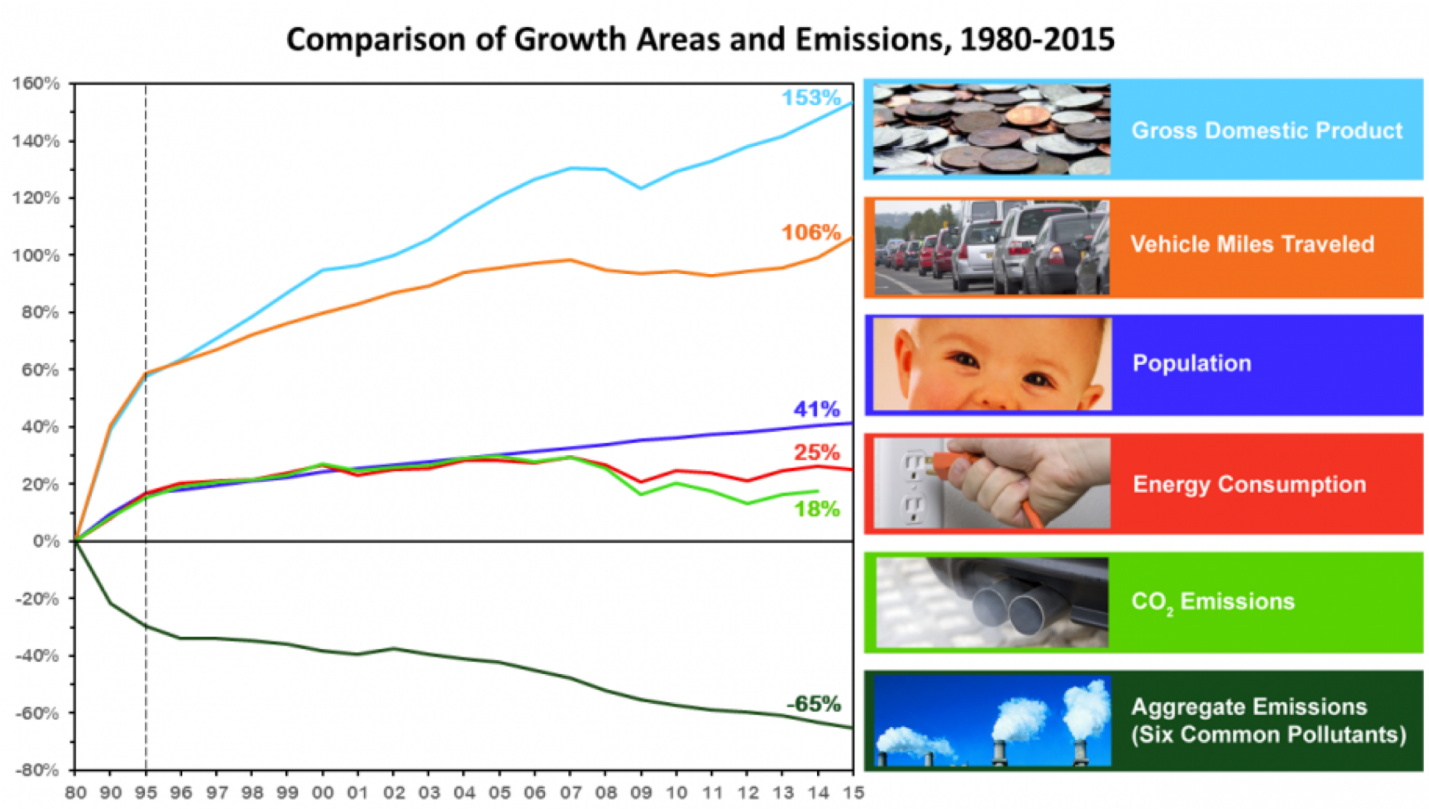
Trends in first birth rates by women ≥35 yrs in the US, 1970–2012





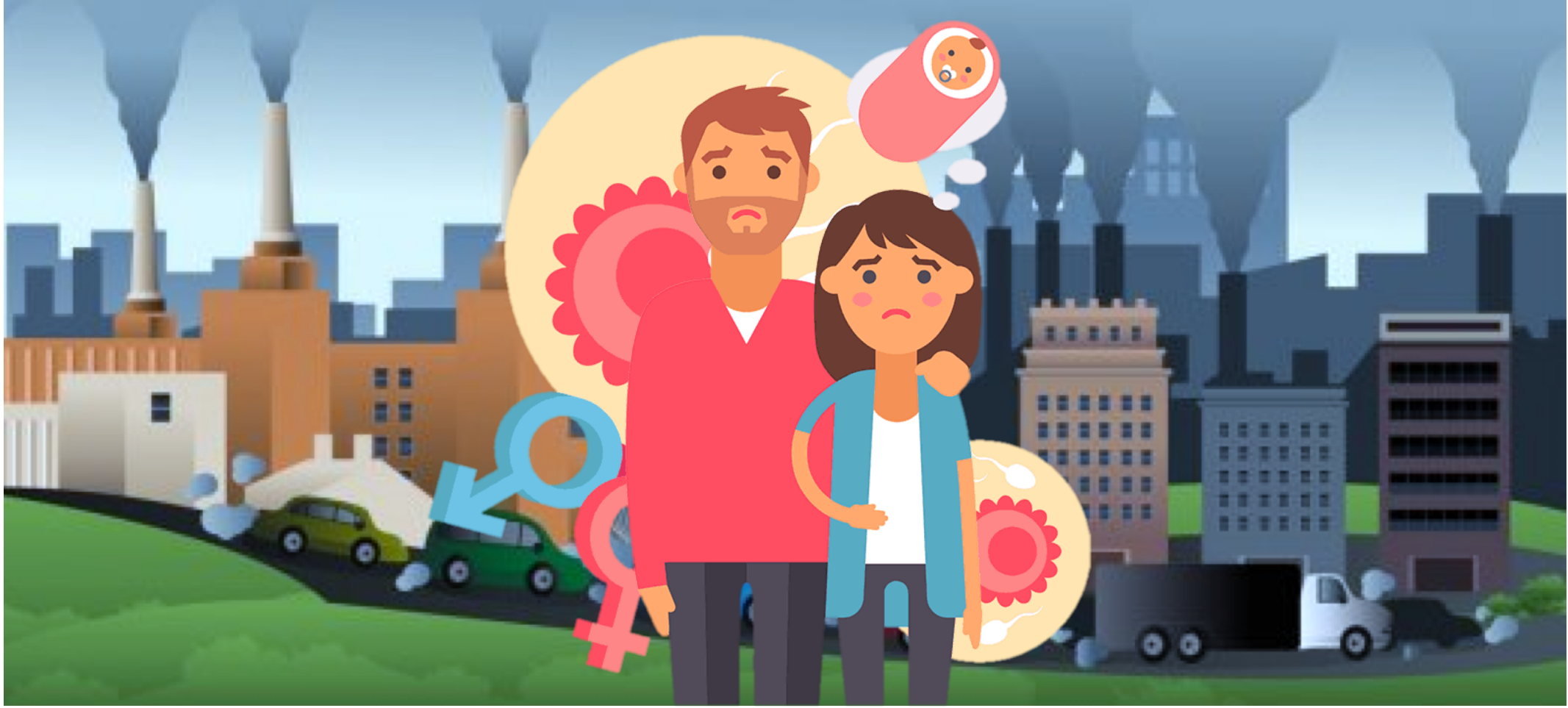
SOURCE: CDC/NCHS, National Vital Statistics System.

Reducing Ambient Air Pollution Through Policy is Key



Environmental Rules Being Rolled Back Under Current Administration

Rule reversals	Completed	In progress	Total
Air pollution and emissions	27	2	29
Drilling and extraction	12	8	20
Infrastructure and planning	12	1	13
Animals	11	2	13
Water pollution	7	2	9
Toxic substances and safety	7	1	8
Other	8	4	12
All	84	20	104



QUESTIONS?

Audrey Gaskins, Sc.D.

Assistant Professor
Department of Epidemiology
Emory Rollins School of Public Health

Email: audrey.jane.gaskins@emory.edu

Twitter: @audreyjane4