

Impacts of transitioning to clean household energy

Evidence from policy reform in peri-urban Beijing

Sam Harper

2024-11-21



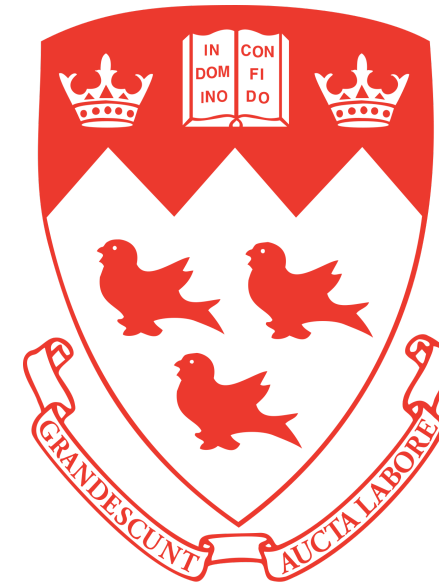
McGill

Department of
Epidemiology, Biostatistics
and Occupational Health

Background

Prior work

- Measuring and monitoring health inequalities
- Analysis and decomposition of life expectancy gaps
- Evaluating the impact of policy interventions



Measurement and analysis of health inequalities

- Methodological development, software, applied analysis

NCI Cancer
Number 6

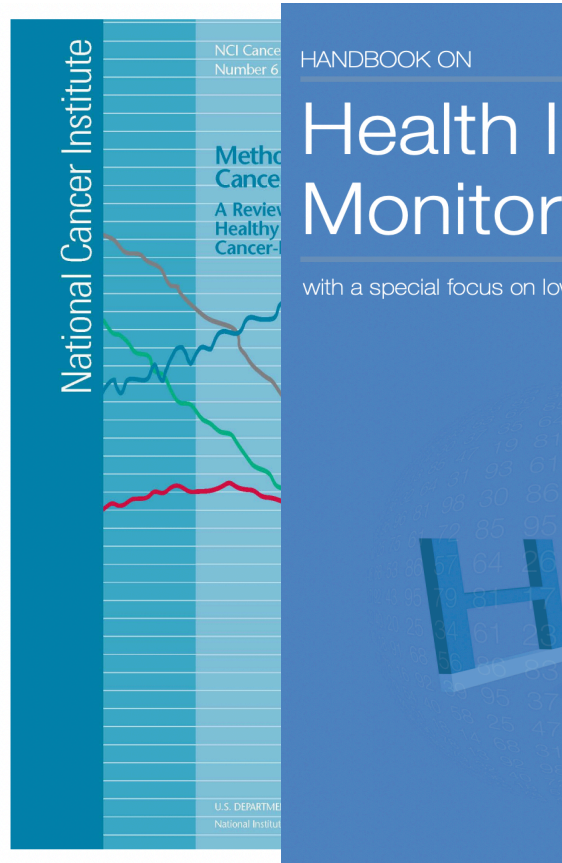
Methods for Measuring Health Inequalities Using Data Relevant to Cancer-Related Populations

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health disparities related to cancer, quantitative
interventions to remove them. NCI Project Offi
Bryce Reeve, Ph.D. (ARP), and Nancy Breen, Ph.



THE MILBANK
A MULTIDISCIPLINARY JOURNAL

Implicit Value Judgments in the Measurement of Health Inequalities

SAM HARPER, NICHOLAS MEERSMAN, MARSHALL NANCY BREEN, and JOHN LYNCH

McGill University; Case Western Reserve University; University of South Australia

Context: Quantitative estimates of health inequalities play a crucial role in identifying and addressing health disparities. It is generally assumed that the measurement process itself is a value-neutral process, providing objective information about the magnitude of disparities. However, the choice of variables to measure and the methods used to analyze these variables can reflect underlying value judgments about what constitutes a health inequality and how it should be measured.

Methods: We discuss five examples of the measurement process itself, three of which are aimed at the exclusion of others, and one which is aimed at the inclusion of others. We discuss the implications of these choices for the measurement of health inequalities.

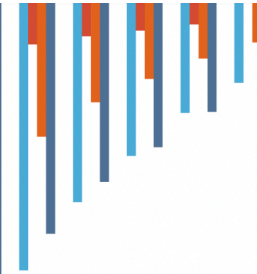
Findings: Overall, we find that the measurement of health inequalities is a value-laden process and that the choice of variables to measure and the methods used to analyze these variables can reflect underlying value judgments about what constitutes a health inequality and how it should be measured.

Conclusions: Because values influence the measurement process, we argue that researchers should be explicit about the value judgments underlying their choice of variables and methods. We also discuss the implications of these choices for the measurement of health inequalities.

Keywords: Health inequalities, measurement, value judgments

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Variance Estimation Intervals for 11 Co-disparity Measures

Abstract: There is increased interest in broadly defined, health disparities to ethnicity, socioeconomic status, and education. To make informed health care decisions, it is important to assess the magnitude of these disparities and to understand the underlying causes. We have developed a new statistical software that provides corresponding 95% confidence intervals for these disparities. We have also conducted a simulation-based method to assess the accuracy of these confidence intervals. Our analyses indicate that the health disparity measures we studied are generally accurate, but some measures show more variability than others.

INTRODUCTION

In recent years, there has been a growing interest in eliminating health disparities expressed by US government agencies, such as the World Bank, the Centers for Disease Control and Prevention, and the World Health Organization. Broadly defined, health disparities refer to preventable inequalities in health status, access to health care, and health care receipt, across different populations. These disparities are often defined by ethnicity, socioeconomic status, gender, and geographic location. It is important to understand the underlying causes of these disparities and to develop strategies to address them. This paper discusses the measurement of health inequalities and the challenges associated with this process. We discuss the importance of being explicit about the value judgments underlying the measurement process and the implications of these choices for the measurement of health inequalities.

USER

Health Equity Assessment

BUILT-IN DATABASE

- Jaell Ahn
- Sam Harper
- Mandi Yu
- Eric J. Feuer
- Benmel Liu
- George Luta



Author affiliations and support information (if applicable) appear at the end of this article. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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CHAPTER FIVE

HEALTH INEQUALITIES: MEASUREMENT AND DECOMPOSITION

Sam Harper and John Lynch

Since the prior edition of this chapter (Harper and Lynch 2006), the literature on measuring and monitoring health inequalities has exploded. The combination of new data sources, particularly in low- and middle-income countries (e.g., Hosseinpoor 2013; de Walque and Filmer 2013), and widespread international concern regarding social determinants of health (WHO Commission on Social Determinants of Health 2008) has led to a wealth of new studies providing quantitative estimates of social inequalities in health. The raft of new studies suggests continued research and policy interest in understanding and reducing health inequalities. We maintain the basic premise of our earlier chapter that reliable and valid measurement of progress toward reducing health inequalities, if it is to be of value in research and policy-making, requires a framework for conceptualizing and measuring inequalities in health (Sen 2002; Asada 2007).

In this chapter we focus on reviewing ways of measuring health inequalities—that is, observable differences in health among individuals of different social groups. We also show that measures of inequality inherently reflect, to a greater or lesser extent, different ethical and value judgments about what aspects of health inequality are important to capture. Thus it is worthwhile to restate that any choice of health inequality statistic implicitly or explicitly reflects a choice about what is important to measure (Sen and Foster 1997; Asada 2007), the consequences of which can strongly affect conclusions

Social inequalities in life expectancy

- Social group differences, time trends, decomposition

ORIGINAL CONTRIBUTION

Trends in the Black-White Gap in the United States

Sam Harper, PhD
John Lynch, PhD
Scott Burris, JD
George Davey Smith, MD

Context Six decades of sharp increases in mortality among blacks have been lower than that of whites.^{1,2} However, overall trends tend to obscure the fact that the gap in life expectancy between blacks and whites has varied considerably during the 20th century. The near elimination of typhoid and other waterborne communicable diseases improved black life expectancy in both absolute and relative terms compared with whites in the period 1900-1940, but black-white differences stabilized during the 1960s.³

Design and methods We examined trends in life expectancy at birth (LE) for blacks and whites in the United States from 1900 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1900 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1900 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1900 to 2014.

Results Life expectancy at birth for blacks and whites in the United States increased from 47.1 and 51.1 years, respectively, in 1900 to 75.3 and 78.8 years, respectively, in 2014. The gap in life expectancy between blacks and whites narrowed from 4.0 years in 1900 to 3.5 years in 2014.

Conclusions The gap in life expectancy between blacks and whites in the United States has narrowed over time, but it remains substantial. This narrowing is largely due to improvements in life expectancy for both groups, but the gap has not closed.

Introduction Life expectancy at birth (LE) is a key indicator of population health. In the United States, life expectancy at birth for blacks and whites has increased steadily since 1900, but the gap between them has remained large.

Methods We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1900 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1900 to 2014.

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Introduction Life expectancy at birth (LE) is a key indicator of population health. In the United States, life expectancy at birth for blacks and whites has increased steadily since 1900, but the gap between them has remained large.

DISPARITIES

RESEARCH LETTER

Trends in the Black-White Life Expectancy Gap 2003-2008

To the Editor: Understanding the causes of black-white differences in mortality has important consequences for interventions to reduce health inequalities in the United States. A previous report found a nearly 2-year decline in the white life expectancy gap among men and a 1-year among women between 1993 and 2003.¹ We investigated whether these changes have continued in recent years.

Table 1. Causes of Death Contributing to the Gap in Life Expectancy

| Cause of Death | 2003 | 2008 |
|------------------------|-------------------|--------------------|
| Cardiovascular | 1.94 (29.7) | 1.75 (27.1) |
| Heart disease | 1.35 (20.7) | 1.19 (18.1) |
| Hypertension | 0.15 (2.2) | 0.16 (2.3) |
| Stroke | 0.41 (6.2) | 0.37 (5.4) |
| Other ^a | 0.03 (0.5) | 0.03 (0.5) |
| Cancers | 0.99 (15.1) | 0.99 (14.6) |
| Colorectal | 0.12 (1.9) | 0.14 (2.0) |
| Lung | 0.29 (4.4) | 0.22 (3.2) |
| Breast | 0 (0) | 0 (0) |
| Prostate | 0.27 (4.1) | 0.26 (3.7) |
| Other ^b | 0.30 (4.6) | 0.27 (3.9) |
| Communicable | 0.93 (14.2) | 0.73 (10.7) |
| Influenza/pneumonia | 0.10 (1.6) | 0.08 (1.1) |
| Septicemia | 0.19 (2.9) | 0.18 (2.6) |
| HIV | 0.57 (8.8) | 0.41 (5.9) |
| Other ^c | 0.07 (1.0) | 0.06 (0.9) |
| Chronic disease | -0.54 (8.3) | -0.42 (6.1) |
| Alzheimer disease | -0.02 (-0.3) | -0.03 (-0.4) |
| CLPD | -0.03 (-0.4) | -0.08 (-1.1) |
| Diabetes | 0.32 (4.8) | 0.30 (4.3) |
| Nephritis | 0.25 (3.8) | 0.25 (3.6) |
| Cirrhosis | 0.02 (0.3) | -0.02 (-0.3) |
| Injuries | 0.91 (14.0) | 0.81 (11.7) |
| Homicide | 1.08 (16.6) | 1.03 (14.7) |
| Suicide | -0.21 (-3.3) | -0.27 (-3.8) |
| Unintentional injuries | 0.04 (0.7) | -0.15 (-2.1) |
| Poisoning | 0 (0) | -0.14 (-2.0) |
| Transportation-related | 0.01 (0.2) | -0.01 (-0.1) |
| Other ^d | 0.03 (0.5) | 0 (0) |
| Infant mortality | 0.51 (7.7) | 0.45 (6.5) |
| Congenital anomalies | 0.05 (0.8) | 0.04 (0.6) |
| Perinatal death | 0.45 (6.9) | 0.41 (5.8) |
| Residual ^e | 0.72 (11.0) | 0.59 (8.5) |
| Total | 6.53 (100) | 5.44 (78.8) |

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By Sam Harper, Richard F. MacLehose, and Jay S. Kaufman

Trends in The Black-White Life Expectancy Gap in 4 US States, 1990-2014

ABSTRACT Nationwide differences in US life expectancy at birth (LE) among blacks and whites may mask considerable differences in policies aimed at reducing health inequities. We examined trends in LE for blacks and whites in 4 US states (California, Georgia, Illinois, and Michigan) from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

Introduction Life expectancy at birth (LE) is a key indicator of population health. In the United States, life expectancy at birth for blacks and whites has increased steadily since 1900, but the gap between them has remained large.

Methods We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

Results Life expectancy at birth for blacks and whites in the United States increased from 47.1 and 51.1 years, respectively, in 1900 to 75.3 and 78.8 years, respectively, in 2014. The gap in life expectancy between blacks and whites narrowed from 4.0 years in 1900 to 3.5 years in 2014.

Conclusions The gap in life expectancy between blacks and whites in the United States has narrowed over time, but it remains substantial. This narrowing is largely due to improvements in life expectancy for both groups, but the gap has not closed.

Letters

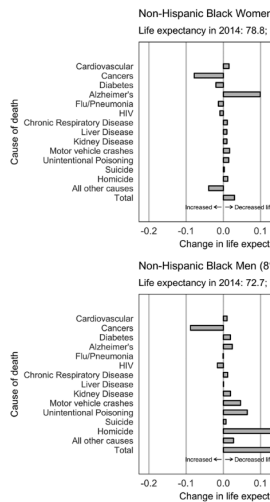


FIGURE. Contribution of cause-of-death groups (into taken from National Center for Health Statistics list of [C00-C97], Diabetes [E10-E14], Alzheimer's disease [C80-C84], Chronic lower respiratory disease [J40-J47], N27]; Motor vehicle crashes [V02-V04, V09, V09.0, V09.1, V82.0-V82.1, V83-V86, V87.0-V87.8, V88.0, V88.1, V88.2, V88.3, V88.4, V88.5, V88.6, V88.7, V88.8, V88.9, V89.0-V89.1], Homicide [U01-U02, X85-V09, Y85-V09], and Suicide [U03-U04], Unintentional Poisoning [T01-T09], and Suicide [U01-U02, X85-V09, Y85-V09], race ethnicity (Race and Hispanic origin were classified into estimates, and were reported separately on the Management and Budget).

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Trends in the contribution of major causes of death to the black-white life expectancy gap by US state

Corinne A. Riddell¹, Kathryn T. Morrison, Jay S. Kaufman, Richard F. MacLehose, and Sam Harper

Department of Epidemiology, Biostatistics & Occupational Health, McGill University, Montreal, Quebec H3A 1A2, Canada

ABSTRACT Life expectancy at birth in the United States (US) was 78.8 years in 2014, a 3.4-year increase since 2010. We examined trends in life expectancy for blacks and whites in 4 US states (California, Georgia, Illinois, and Michigan) from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

1. Introduction

Life expectancy is a barometer for overall population health. In the United States, life expectancy at birth for blacks and whites has increased steadily since 1900, but the gap between them has remained large.

Methods We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

Results Life expectancy at birth for blacks and whites in the United States increased from 47.1 and 51.1 years, respectively, in 1900 to 75.3 and 78.8 years, respectively, in 2014. The gap in life expectancy between blacks and whites narrowed from 4.0 years in 1900 to 3.5 years in 2014.

Conclusions The gap in life expectancy between blacks and whites in the United States has narrowed over time, but it remains substantial. This narrowing is largely due to improvements in life expectancy for both groups, but the gap has not closed.

Research

Black and White Differences in Life Expectancy in 4 US States

Jay S. Kaufman, PhD¹; Corinne A. Riddell, PhD¹; and Sam Harper, PhD¹

Abstract

Objectives: Racial differences in mortality in the United States have been large and persistent. We examined trends in life expectancy for blacks and whites in 4 US states (California, Georgia, Illinois, and Michigan) from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

Methods: We extracted data on the number of deaths from the HMD to estimate LE for blacks and whites in the United States from 1990 to 2014. We used data from the Human Mortality Database (HMD) to estimate LE for blacks and whites in the United States from 1990 to 2014.

Results: The racial gap in life expectancy at birth decreased from 4.0 years in 1990 to 3.5 years in 2014. The gap in life expectancy between blacks and whites narrowed from 4.0 years in 1990 to 3.5 years in 2014.

Conclusions: Future research should identify policy interventions to reduce racial disparities in life expectancy.

Keywords: mortality, race, inequality

Racial differences in mortality in the United States have been a bellwether of progress in equity and health. The gap in life expectancy between blacks and whites has narrowed in mortality over time, but it remains large. This narrowing is largely due to improvements in life expectancy for both groups, but the gap has not closed.

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ANNUAL REVIEWS

Annual Review of Public Health

Declining Life Expectancy in the United States: Missing the Trees for the Forest

Sam Harper,^{1,2,3} Corinne A. Riddell,⁴ and Nicholas B. King^{1,2,5}

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Impact of interventions and policies

THE CHANGING FACE OF EPIDEMIOLOGY

Editors' note: This series addresses topics of interest to epidemiologists across a range of specialties. Commentaries start as invited talks at symposia organized by the Editors. This paper was presented at the Third North American Congress of Epidemiology held in Montreal in June 2011.

Social Epidemiology

Questionable Answers and Answerable Questions

Sam Harper^a and Erin C. Strumpf^{a,b}

Social epidemiology encompasses the study of relationships between health and a broad range of social factors such as race, social class, gender, social policies, and so on. One could broadly partition the work of social epidemiology into surveillance (ie, descriptive relationships between social factors and health, tracking of health inequalities over time) and etiology (ie, causal effects of social exposures on health).¹ Many social epidemiologists believe these twin pursuits should ultimately serve to structure interventions aimed at reducing health-damaging social exposures or increasing exposure to social factors that enhance health.

Impact of interventions and policies

- Substance use, maternal / child health, social and economic policies



Do Medical Marijuana Laws and Extension

SAM HARPER, PhD, ERIN C. S*

PURPOSE: To replicate a passed medical marijuana laws used state characteristics and **METHODS:** We obtained a Survey on Drug Use and Health previous results. We used di MMLs on marijuana use, and **RESULTS:** We replicated p Difference-in-differences estimates by 0.53 percentage point the perceived riskiness of marijuana use yielded little **CONCLUSIONS:** Account error had an important effect: evidence of causal effects of *J Ann Epidemiol* 2012;22:207–21

KEY WORDS: Adolescents, Health, Quasi-Experiments.

INTRODUCTION

The potential impact of legalizing medicinal both medical and recreational marijuana is a popular and legislative attention (1) study. In a recent issue of the *Annals*, V used to this literature by analyzing if marijuana use among adolescents in US and have not passed a law legalizing marijuana purposes (2). They reported evidence that we were higher in states that had passed r laws (MMLs) compared with states that h but concluded that the causal mechanism determined. In this paper, we replicat Wall et al. and, using the same data, we effect of passing MMLs on measures of m

METHODS

Wall et al. were transparent with respect and methods, which greatly facilitated

From the Department of Epidemiology, Biostatistics Health (S.H., E.C.S., J.S.K.) and Department of McGill University, Montreal, Canada. Address correspondence to: Sam Harper, PhD, D olary, Biostatistics & Occupational Health, McGill Avenue West, Room 34B, Montreal, QC H3A 1A 398-2856; Fax: 514-398-4503. E-mail: sam.harper@mcgill.ca Received October 12, 2011. Accepted December 30, 2012.



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The Ann

Sam Harper, J

ABSTRACT Background: Ca driving and fatal c the potential for g cannabis celebrati to date is limited. **Methods:** We us Reporting System the impact of 4/2 crashes occurring USA. We compare other major holdi of 4/207 had that **Results:** Between associated with an involved in fatal c relative to control when compared v and after (IRR 1.0 days of the year 0 all years we found drivers involved in daily variations. **Conclusions:** The population-wide e on the number of

Correspondence to: Dr Sam Harper, Epidemiology, Biostatistics & Occupational Health, McGill University, Montreal, QC H3A 1A2, Canada; sam.harper@mcgill.ca Received 7 November 2018 Revised 11 December 2018 Accepted 16 December 2018

INTRODUCTION

The potential r ment may play limited evidence ational cannabis potential impact crash risks is ne a substantial bur increases in drug studies have sug use impairs driv Another stran lation-level risk suggested that r approximate de there is import and quality." C studies found ti cannabis had re after passing leg interpreted as a and alcohol m younger people, more likely to ce after passing leg However, m driving have eit

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The Effect of Man Belt Laws on Socioeconomic P

ABSTRACT Background: Ca driving and fatal c the potential for g cannabis celebrati to date is limited. **Methods:** We us Reporting System the impact of 4/2 crashes occurring USA. We compare other major holdi of 4/207 had that **Results:** Between associated with an involved in fatal c relative to control when compared v and after (IRR 1.0 days of the year 0 all years we found drivers involved in daily variations. **Conclusions:** The population-wide e on the number of

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Research report

Economic the 'Great

Arijit Nandi, 1,



Original article

Did the Great Recession in from an interrupted time-

Sam Harper PhD*, Tim A. Bruckner

Department of Epidemiology, Biostatistics & Occupational I and Program in Public Health, University of California, I

ARTICLE INFO

Article history: Received 27 September 2016 Accepted 24 May 2017 Available online 1 June 2017

Keywords: Great Recession; Time series; Suicide; Motor vehicle crashes

Background

The worldwide financial crisis of the renewed interest in how economic conditio health. In particular, several studies have after impact of economic recessions on deaths 1 Recent reviews of the evidence generally deaths rise during economic recessions, but t effect varies across social contexts [1–1 studies of the impact of the "Great Recession" reported large numbers of excess suicides particularly in the United States [1,4,7,14]. Despite a number of studies on this topic with prior studies remain. First, some stud

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PLOS MEDICINE



Original article

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Keywords: Great Recession; Time series; Suicide; Motor vehicle crashes

Background

The worldwide financial crisis of the renewed interest in how economic conditio health. In particular, several studies have after impact of economic recessions on deaths 1 Recent reviews of the evidence generally deaths rise during economic recessions, but t effect varies across social contexts [1–1 studies of the impact of the "Great Recession" reported large numbers of excess suicides particularly in the United States [1,4,7,14]. Despite a number of studies on this topic with prior studies remain. First, some stud

INTRODUCTION

The potential r ment may play limited evidence ational cannabis potential impact crash risks is ne a substantial bur increases in drug studies have sug use impairs driv Another stran lation-level risk suggested that r approximate de there is import and quality." C studies found ti cannabis had re after passing leg interpreted as a and alcohol m younger people, more likely to ce after passing leg However, m driving have eit

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ARTICLE

Access to affordable daycare and women's economic opportunities: evidence from a cluster-randomised intervention in India

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ABSTRACT

We used data from a cluster-randomized trial in rural Rajasthan, India to evaluate the impact of providing access to a community-based daycare program on women's economic outcomes two years later. The sample included 2858 mothers with age-eligible children. Providing access to daycare led 43% of households to utilize them. The intervention reduced time on childcare by 16.0 minutes/day (95%CI=10.6, 42.5) and increased the probabilities that women were paid in cash and spent time during the prior day on paid work by 2.3 (95%CI=0.0, 4.5) and 2.6 (95%CI=0.9, 4.4) percentage points. Other indicators of labor force participation and income were unaffected.

ARTICLE HISTORY

Received 27 December 2017 Accepted 20 May 2020

KEYWORDS: India; daycare; time use; employment; economic opportunity; cluster-randomised trial

Introduction

Objectives and study context

There is a lack of credible research for constructing evidence-based policies for improving access to daycare in India in ways that benefit health and socioeconomic well-being, particularly for women and young children. This paper presents the initial findings from a cluster-randomised trial, named the *Uttam Unnati* ('great progress') study, which aims to address this research gap. The overarching objective of the study is to evaluate the effect of providing access to an affordable, community-based daycare programme, operated by the non-governmental development organisation Seva Mandir, on health, socioeconomic well-being, and empowerment among women living in rural Rajasthan, India.

This study takes place in the Udaipur district of Rajasthan, India. Relative to other Indian states, Rajasthan performs poorly in terms of gender equality in educational and economic outcomes. Based on the Indian National Family Health Survey (NFHS), the sex ratio (girls per 1000 boys) of children aged 6–17 years who attended school in Rajasthan was 745 in 2005–6. Furthermore, only 11.3 percent of women in Rajasthan ages 20–49 years had 10 or more years of education. These figures ranked Rajasthan lowest among all states in India (Kishor and Gupta 2009). Data from the most recent NFHS, conducted in 2015–6, show that only one-half of women in the Udaipur district were literate, compared to 84.3% of men. Among women between 20 and 24 years of age, 40.4% were married before age 18 years.

CONTACT: Arijit Nandi arijit.nandi@mcgill.ca [✉] Institute for Health and Social Policy & Department of Epidemiology, McGill University, Montreal QC H3A 1A3, Canada [✉] Supplemental material for this article can be accessed here. © 2020 Informa UK Limited, trading as Taylor & Francis Group

Current projects

Early Childhood Education Policies and Examining the role of discrimination in labor force participation in India



Photo: <http://policynote.ca>

(with [Arijit Nandi](#), [Emis Akbari](#), [Jody Heymann](#), and [Linda White](#))

This project aims to investigate how Early Childhood Education and over time in the United States and how these policies affect children's health, and well-being.

The project's main objectives are to:

1. Create a free and publicly-available longitudinal database of state programmatic features, including those regulating access to early childhood education from 1995 to present;
2. Estimate the impact of specific state ECEC reforms on the development of non-cognitive skills, health, and well-being, as well as heterogeneity by race/ethnicity, and socioeconomic position; and
3. Estimate the effect of children's participation in ECEC on the development of cognitive skills, health, and well-being, as well as heterogeneity by race/ethnicity and socioeconomic position.



Photo: India Express

(with [Arijit Nandi](#), Anoushaka Chandrashekar, Rosa Abraham, [Nick K](#)

The objective of this project in the longer term is to estimate the impact of hiring behavior in India. Using an experimental "correspondence study" where applications from fictitious candidates for positions advertised in India vary in the magnitude of gender discrimination, measured by the gender discrimination index, which varies based on the characteristics of the applicant (e.g., age, occupation, time vs. full-time work, industry, number of employees). Additionally, the magnitude of gender discrimination in callbacks is greater for women of child-bearing age with a school-aged child, depending on whether the prospective employer is stipulated by the 2017 Amendment to the Indian Maternity Benefit Act.



Photo: The Straits Times

(with [Jill Baumgartner](#))

Air pollution is a leading public health problem. Over 400 million Chinese homes burn coal to meet their indoor space heating needs, leading to high levels of air pollution and health impacts in adults and children. Coal burning in China also contributes to poor air quality and mercury contamination in Canada. This project will assess how transitioning away from coal and introducing new clean heating technology in China will impact the health and environment of people who live in homes impacted by policy changes.

Funding: Canadian Institutes for Health Research

A photograph of a coal yard. In the foreground, two green electric trikes are parked on a dirt path. A man in a dark jacket is working with a shovel near a large pile of coal and several white sacks. Another person in a yellow jacket is visible in the background near another pile of coal. The scene is set in front of a building with a brick chimney and a concrete wall. The sky is overcast, and there are bare trees in the background.

Impacts of a Clean Energy Transition Policy

Interdisciplinary Team

McGill University

- Sam Harper (Epidemiology)
- Jill Baumgartner (Epidemiology)
- Brian Robinson (Geography)
- Chris Barrington-Leigh (Economics)
- Koren Mann (Toxicology)
- Arijit Nandi (Epidemiology)
- Robert Platt (Biostatistics)

Colorado State University

- Ellison Carter (Engineering)
- Xiaoying Li (Engineering)

Chinese Academy of Sciences

- Yuanxun Zhang (Air Chemistry)
- Zhongjie Fan (Cardiology)

Peking University

- Shu Tao (Environmental Science)
- Yaojie Li (project coordinator)

China National Center for Cardiovascular Disease

- Liancheng Zhao (CVD epidemiology)

Knowledge Users

- Barry Jessiman (Health Canada)
- Alison Dickson (Environ & Climate Change Canada)
- Iris Jin, Asia Pacific Foundation of Canada
- Richard Fuller, Pure Earth Foundation

Funders

- Canadian Institutes of Health Research
- Health Effects Institute

Why Did We Start?

The role of coal in China

~ 30% of global emissions



Still dominated by coal

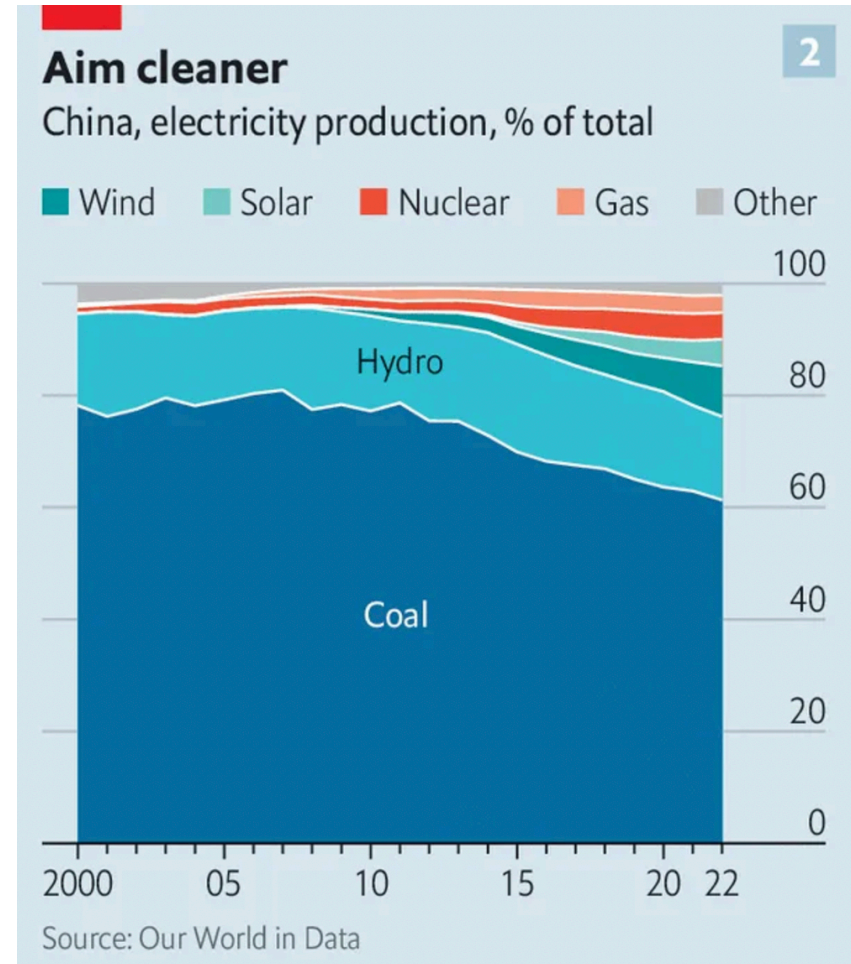
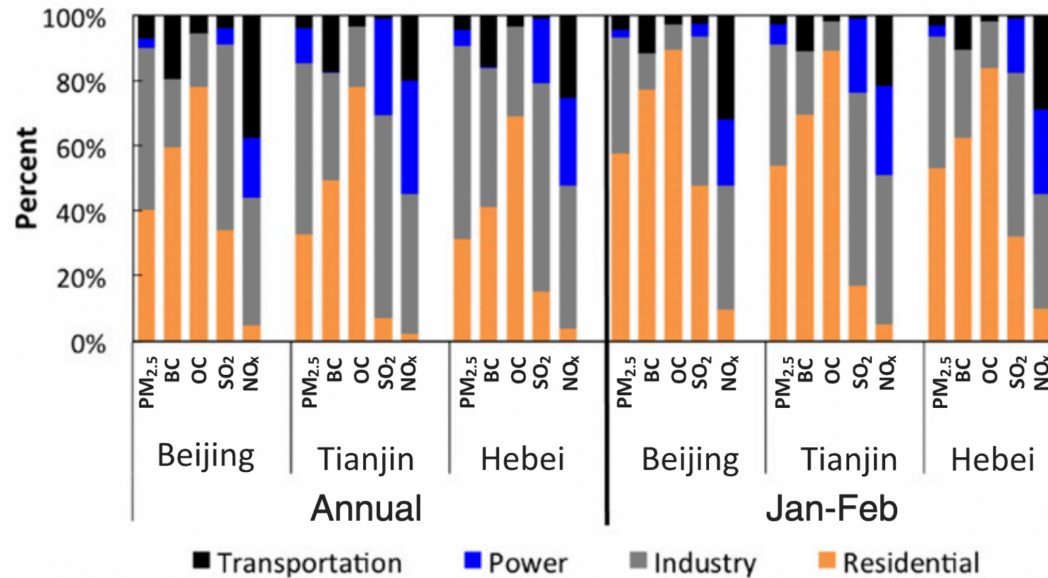


Image credits: [The Economist](#)

Residential coal burning in China



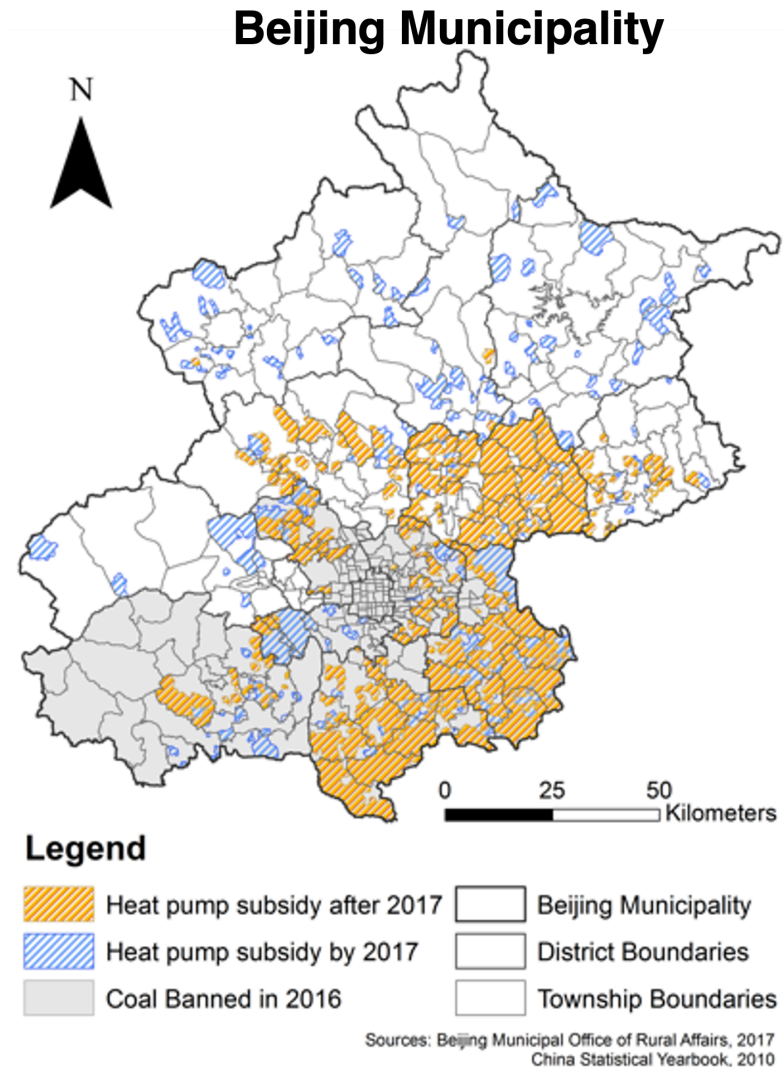
- Coal contains fluorine, arsenic, lead, selenium and mercury, which are not destroyed by combustion;
- Technical constraints make it difficult to burn coal cleanly in households;

- Residential coal burning makes a substantial contribution to emissions
- Particularly in winter months



Policy Context

- Beijing designated “coal restricted areas”
- Government subsidized electric or gas-powered heat pumps (80% of \$4,500 cost)
- 2017: required 1.5 million people to halt coal use (scaled to >2 million by ambitious local officials)
- Stepped implementation from 2017-2021 in Beijing and northern China (63 million homes)



“Coal to Clean Energy Program”

- Village-level intervention.
- Subsidized purchase of heat pump; electricity subsidized regionally.
- Remove coal stoves.
- Retrofit existing homes or build new homes in the village.



In China's Coal Country, a Ban Brings Blue Skies and Cold Homes

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By STEVEN LEE MYERS FEB. 10, 2018



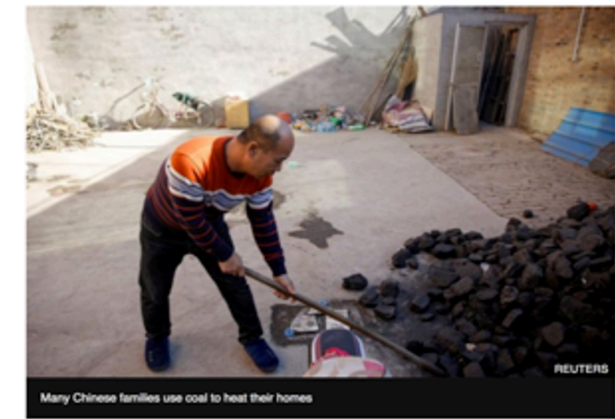
A woman farmer tying a bunch of firewood as her son watches outside their home in Hutou village on Pingtan island. (DOR CHAI HIN/AFP/Getty Images)

Coal Ban Forces Chinese Living in Frigid North to Burn Furniture to Keep Warm

China does U-turn on coal ban to avert heating crisis

8 December 2017

Share f t v e Share



Many Chinese families use coal to heat their homes

China's government has allowed some northern cities to burn coal in a

NEWS November 22, 2018 Share f t v e ... Aa

China eases northern home coal ban to offset gas shortage

Push for use of cleaner fuel set back by cold weather and rising prices



Coal powder briquettes have been identified as a particular hazard to health © AFP

Lucy Hornby in Beijing DECEMBER 7, 2017...

Home Cambodia China Laos North Korea Myanmar Tibet Uyghur Vietnam

HOME | COMMENTARIES | ECONOMY WATCH

China Backtracks on Local Coal Ban

An analysis by Michael Lelyveld 2018-12-10



Workers sort coal on a conveyor belt near a coal mine in Datong, northern China's Shanxi province, Nov. 20, 2015.

Poor bear brunt of Beijing coal cleanup with no heating at -6C

Switch from coal to gas has left residents of towns around Beijing without heating after gas supply falters, reports Climate Home News



pipeline construction on the outskirts of Beijing. There is a demand-supply gap for gas after coal st...

middle class Beijingers breathe the cleanest air in recent winters, in Zhou, a small city 20 minutes by train from Beijing's downtown, residents suffering through cold nights without heating. The reason: a five-year anti-pollution drive has forced rural areas in northern China to switch from dirty...

NEWS ARTS & LIFE MUSIC SHOWS & PODCASTS SEARCH



Goats and Soda STORIES OF LIFE IN A CHANGING WORLD

ENVIRONMENT

The Good News (And Not So Good News) About China's Smoggy Air

December 18, 2018 · 11:36 AM ET

China plans to cut coal heating again, but can it avoid another crisis?

Attempts to cut back on coal use have improved air quality, but reportedly left millions without proper heating

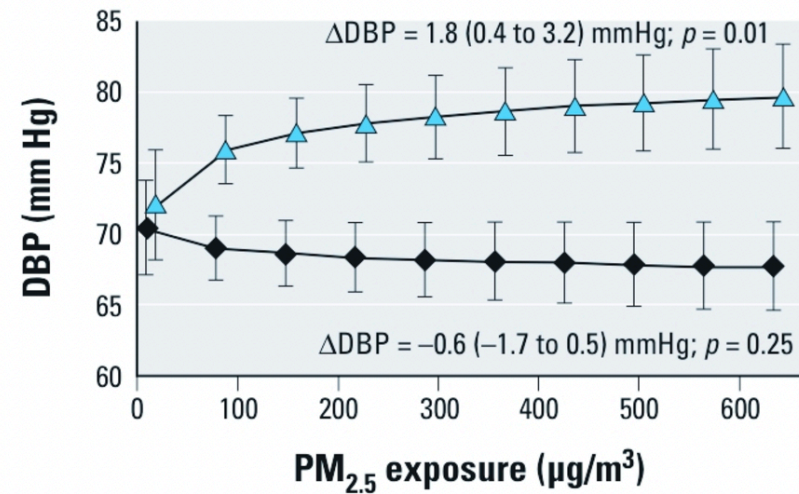
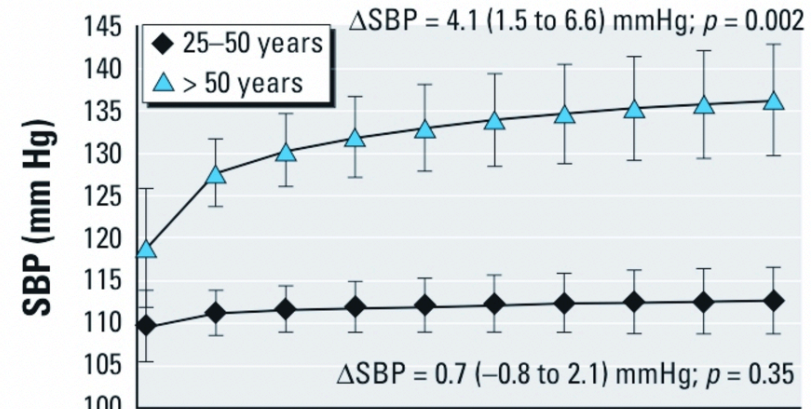
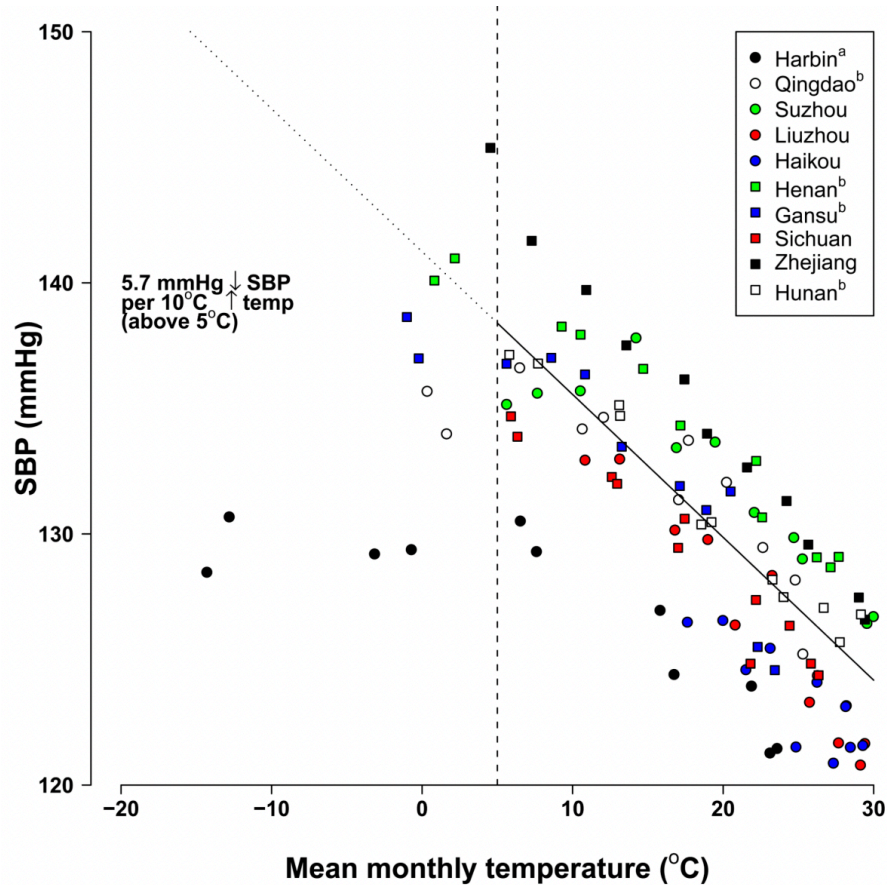
10.01.2018 by Lauri Myllyvirta and Xinyi Shen

@laurimyllyvirta



A Chinese woman hangs laundry in front of her house near a coal fired power plant. Photo: Kevin Frayer/Getty Images

Low indoor temps and higher PM_{2.5} increase BP



Images: Lewington et al. (2012), Baumgartner et al. (2011). Also see Sternbach et al. (2022)

Research Gaps

- Most prior work only on cookstoves
- Several RCTs
- Mixed evidence on air pollution
- Challenges with uptake
- Multiple sources (e.g., stove-stacking)
- Unclear whether possible to scale-up
- Weaker and mixed evidence on health impacts, even when HAP reduced

Household energy solutions need to go beyond cooking interventions alone; there are multiple sources that contribute to HAP

AMERICAN THORACIC SOCIETY DOCUMENTS

Household Air Pollution Interventions to Improve Health in Low- and Middle-Income Countries

An Official American Thoracic Society Research Statement

Peggy S. Lai*, Nicholas L. Lam*, Bill Gallery, Alison G. Lee, Heather Adair-Rohani, Donee Alexander, Kalpana Balakrishnan, Iwona Bisaga, Zoe A. Chafe, Thomas Clasen, Anaité Díaz-Artiga, Andrew Grieshop, Kat Harrison, Stella M. Hartinger, Darby Jack, Seyram Kaali, Melissa Lydston, Kevin M. Mortimer, Laura Nicolaou, Esther Obonyo, Gabriel Okello, Christopher Olopade, Ajay Pillarisetti, Alisha Noella Pinto, Joshua P. Rosenthal[‡], Neil Schluger, Xiaoming Shi, Claudia Thompson[‡], Lisa M. Thompson, John Volckens, Kendra N. Williams, John Balmes[§], William Checkley[§], and Obianuju B. Ozoh[§]; on behalf of the American Thoracic Society Assembly on Environmental, Occupational, and Population Health

THIS OFFICIAL RESEARCH STATEMENT OF THE AMERICAN THORACIC SOCIETY WAS APPROVED FEBRUARY 2024

Overall Study Objectives

Aim 1. 👉

Estimate the total effect of the intervention.

Aim 2. ❌

Estimate the contribution of changes in the chemical composition of $PM_{2.5}$ to the overall effect on health outcomes.

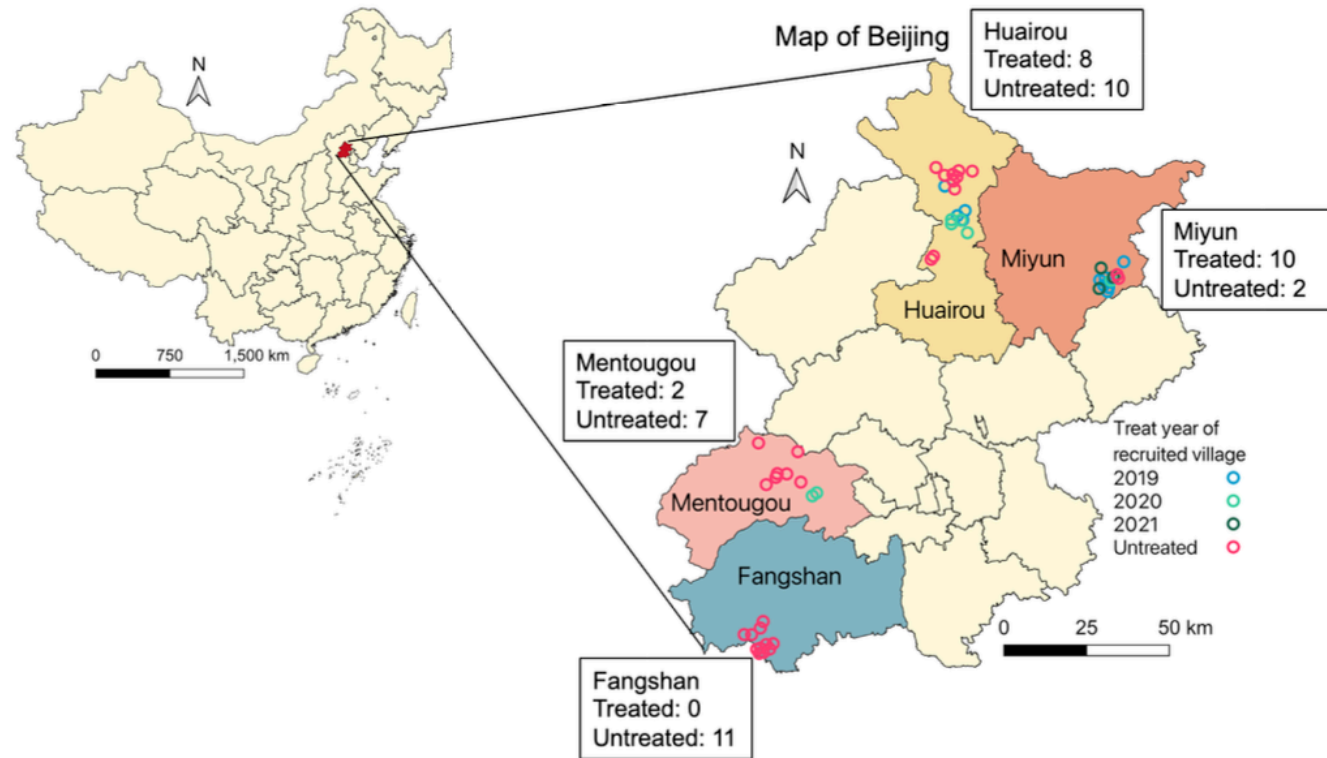
Aim 3. 👉

Examine alternative [pathways and mechanisms](#) that may contribute to the intervention's impact.

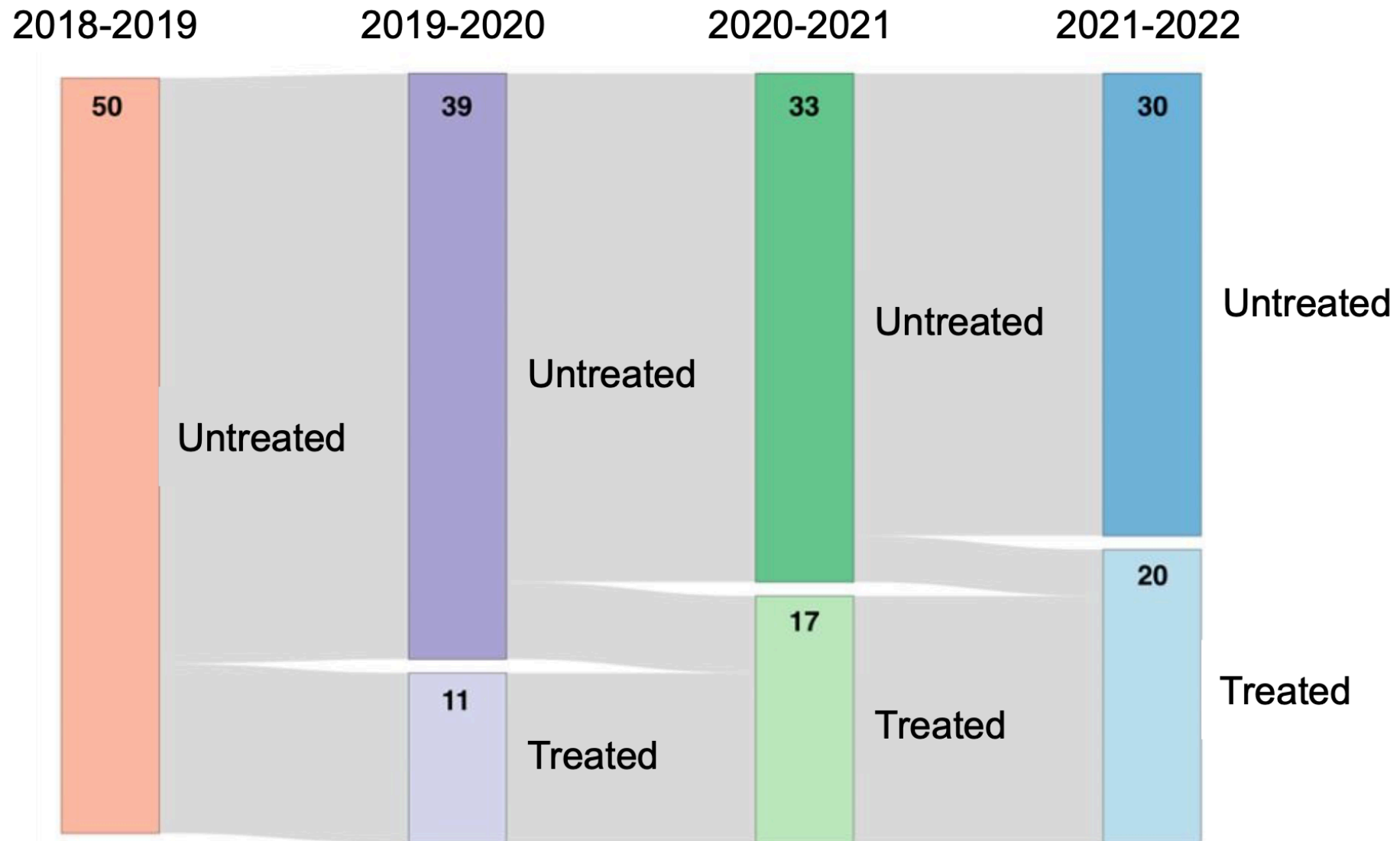
What Did We Do?

Village sampling

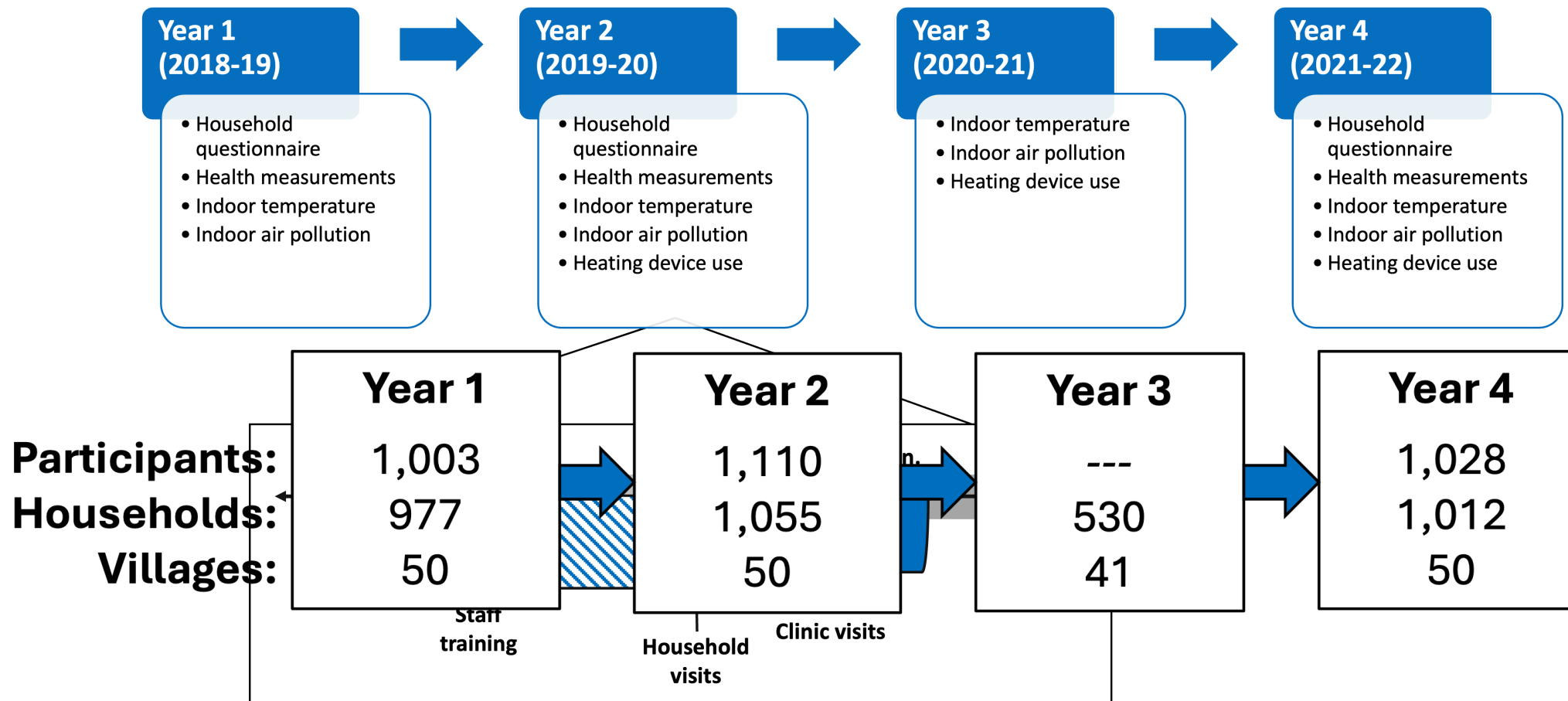
- Identified 50 villages not yet exposed to policy
- Randomly selected ~20 homes in each village
- Enrolled 1 individual per home



Timing of study village treatment by the policy



Data Collection Overview



Measurements

Village

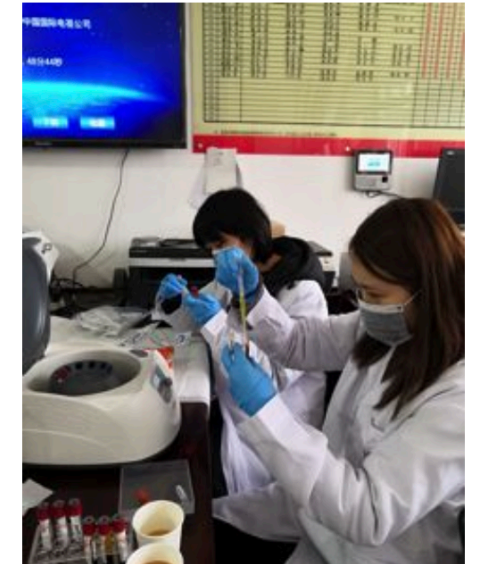
- Outdoor air pollution (1-2 months per season)
- Information on village policies/programs

Household

- Questionnaire to assess energy patterns and related expenditures
- Indoor air temperature (~75% of homes for 2+ winter months)
- Electricity use based on meters

Individual

- Questionnaires on health status, behaviors, conditions, and medication use
- Exposures to $PM_{2.5}$ and black carbon (50% of participants)
- Health measurements (BP, self-reported respiratory symptoms, blood inflammatory and oxidative stress markers (~75%), grip strength (~75%), airway inflammation via exhaled NO (~25%)



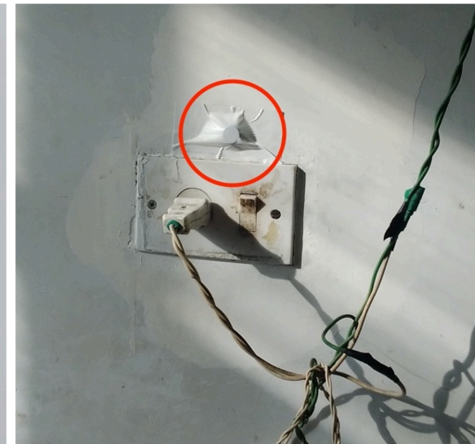
Blood pressure measurement

- Automated oscillometric device.
- Calibrated by manufacturer before Years 1 and 4.
- Home BP measurement by trained staff.
- Measured blood pressure 3 to 5 times on participants supported right arm, after 5 mins of quiet, seated rest.
- Mean of final 2 measurements used in analysis.



Indoor temperature

- Measured indoor temperature in the 5-min before BP.
- Long-term measurement in a subsample of households with sensor taped to household wall.
- Thermochron iButton or LabJack Digit-THL sensors.
- Interior wall of most commonly used room.
- 1.5m height (~ participant height).
- Measured 5-12 months
- 125-min sampling interval.



Indoor air pollution (PM_{2.5})

1. Long-term measurement with real-time sensors.

- 6 households per village.
- Run with standard measurements (BAM/TOEM) pre- and post-data collection, each year.
- Measured 5-mo., 1-min sampling interval



2. 24h measurement with filter-based instrument.

- 3 households per village.
- Accepted (gold-standard) measurement.
- Used to calibrate real-time measurements.



Basic idea for mediation study

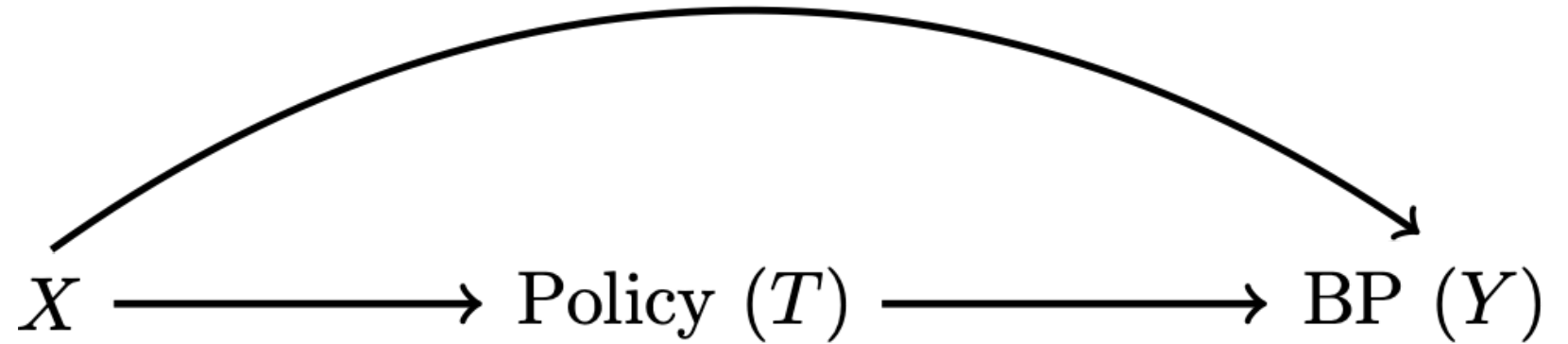
To understand the pathways, mechanisms, and intermediates through which a treatment affects an outcome.

How much of the policy effect is through:

- Reduced exposure to PM_{2.5}
- Other pathways (indoor temperature, behavioral changes)
- Consider multiple mediators

First part of mediation: total effect

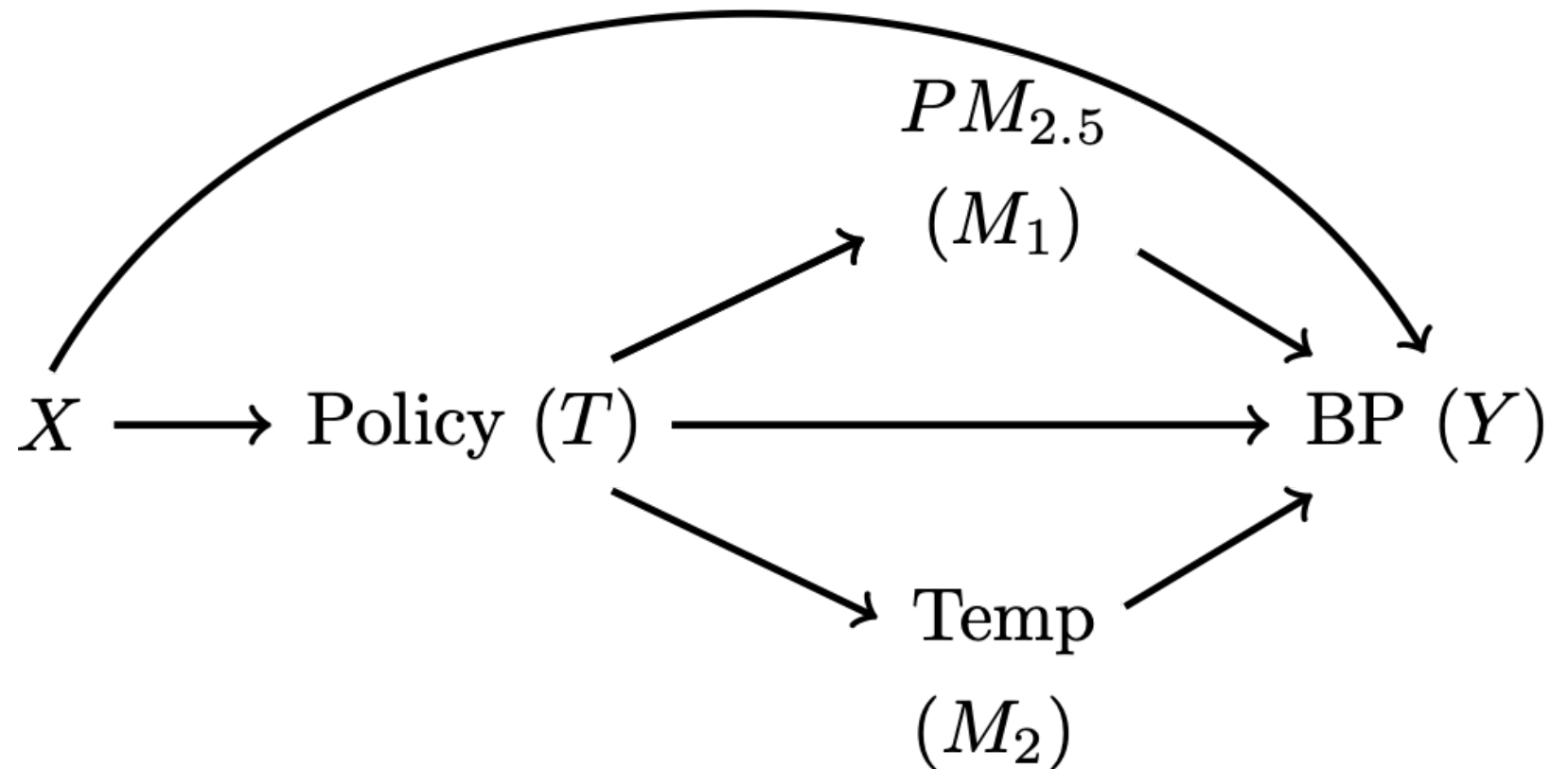
Step 1: Estimate the total effect of T .



Second part of mediation: decomposition

Basic idea: understand pathways of effects

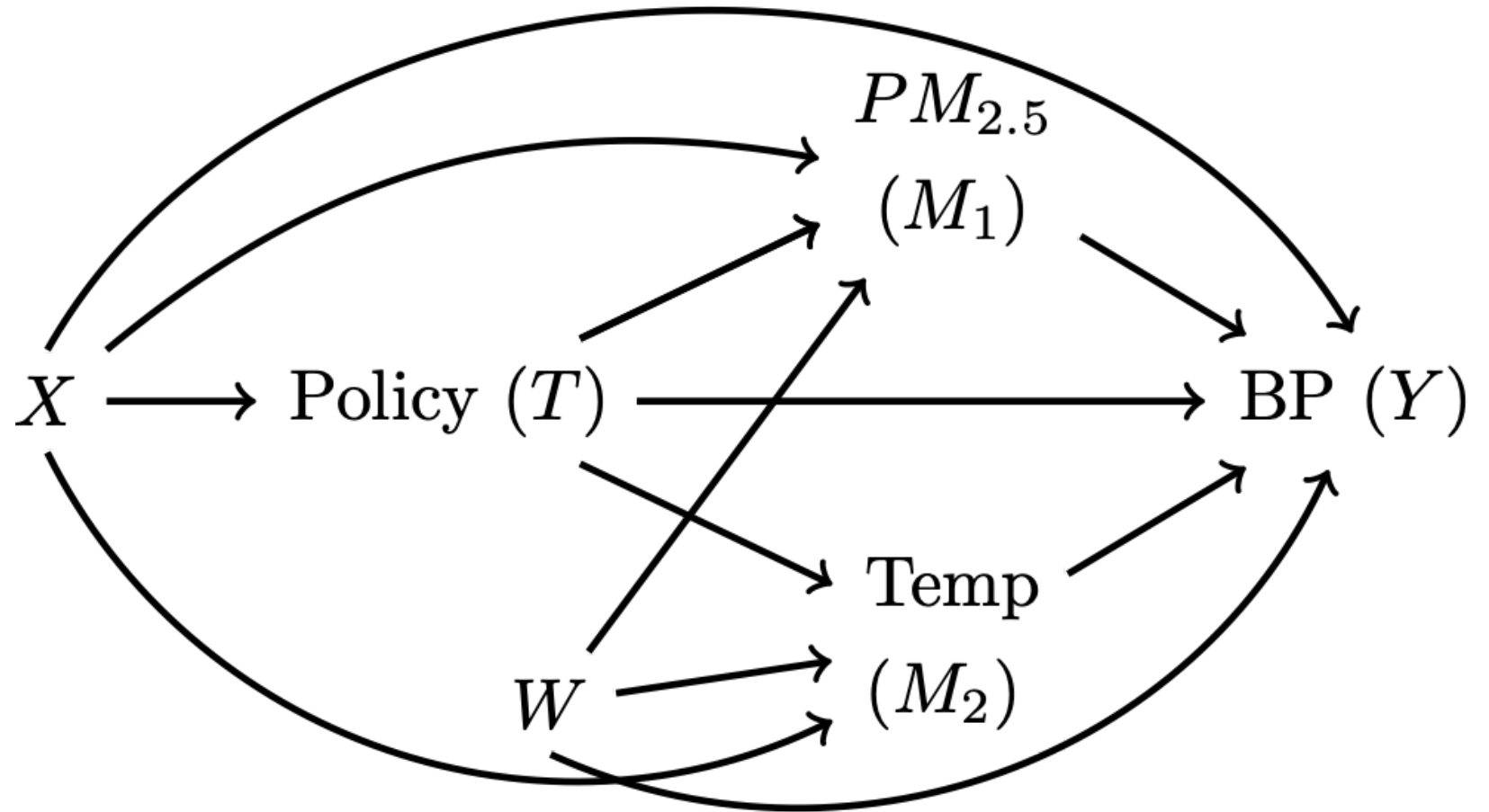
Step 2: Estimate how much of the total effect is due to $PM_{2.5}$ vs. other pathways?



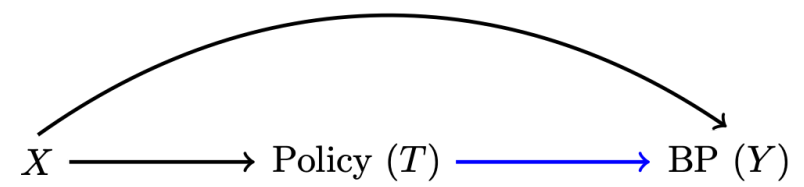
Second part of mediation: decomposition

Basic idea: understand pathways of effects

Step 2: Estimate how much of the total effect is due to $PM_{2.5}$ vs. other pathways?



Quantities of interest



Total effect:

$$E[Y|T, X] = \beta_0 + \beta_1 T + \beta_2 X$$

This equation estimates the total effect of the ban:

$$TE = \beta_1 (T^* - T)$$

where T^* is exposure to ban and T is no exposure.

Mediation model

Estimate two regressions:

1. Treatment on mediator:

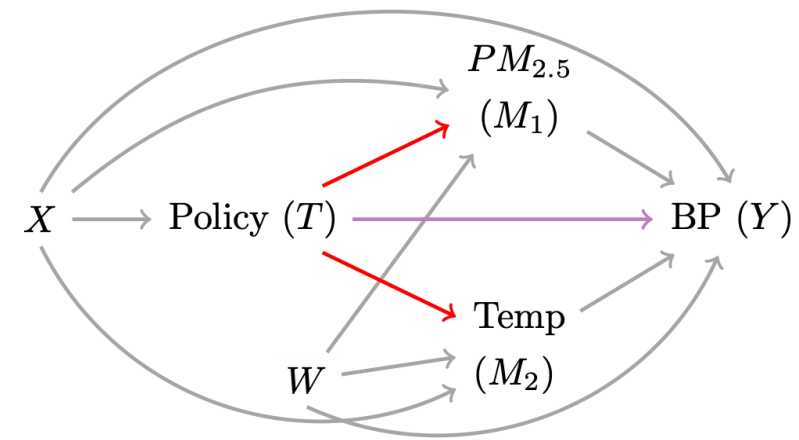
$$E[M|T, X] = \beta_0 + \beta_1 T + \beta_2 X$$

2. Treatment and mediator on outcome:

$$E[Y|T, X, M] = \theta_0 + \theta_1 T + \theta_2 M + \theta_3 TM + \theta_4 X + \theta_5 W$$

Second equation estimates the “Controlled Direct Effect”:

$$CDE = \theta_1 + \theta_3 TM$$



See VanderWeele (2015). Other quantities include the “Natural Direct Effect” $(\theta_1 + \theta_3(\beta_0 + \beta_1 + \beta_2))$ and the “Natural Indirect Effect” $(\theta_2\beta_1 + \theta_3\beta_1)$

What the hell is the CDE?

Interpretation

This effect is the contrast between the counterfactual outcome if the individual were exposed at $T = t$ and the counterfactual outcome if the same individual were exposed at $T = t^$, with the mediator set to a fixed level $M = m$.*

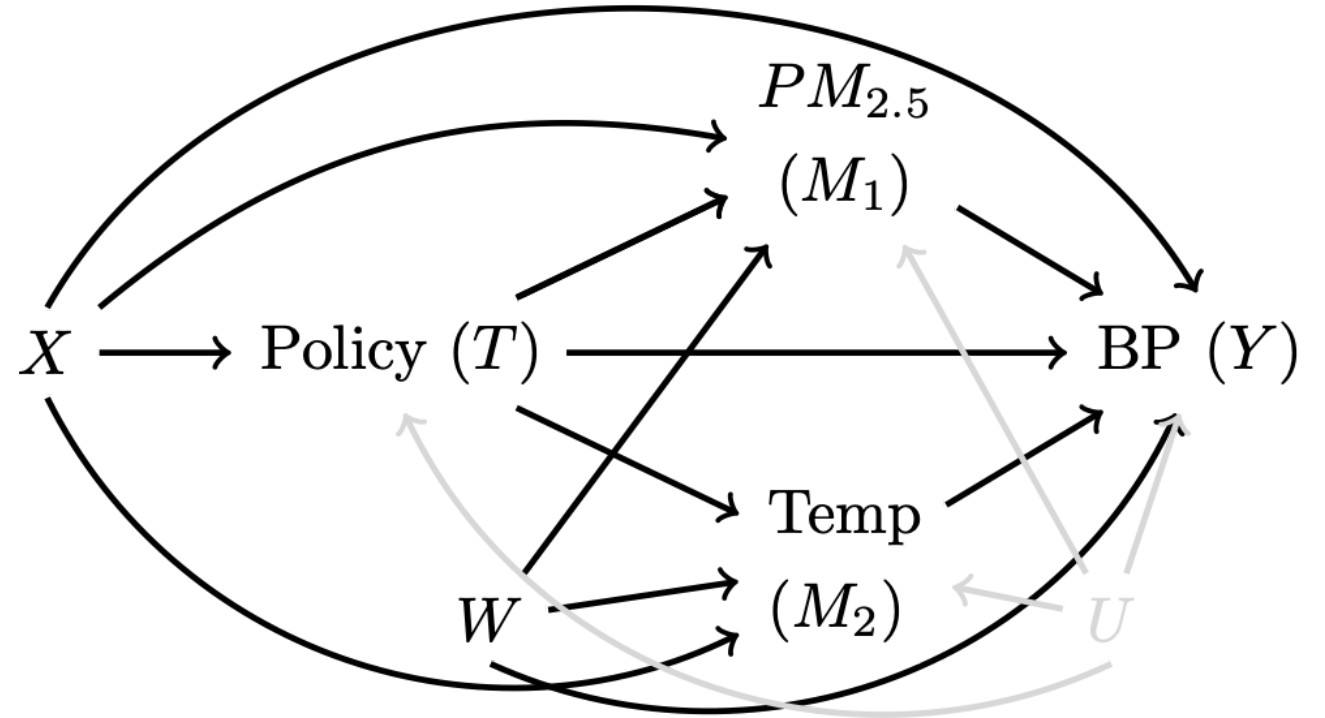
English:

“How much would blood pressure change if the policy were implemented and we held $PM_{2.5}$ fixed at m ?”

Key assumptions

Assumptions for valid CDE:

- No confounding of the total effect.
- No confounding of the mediator-outcome effect.

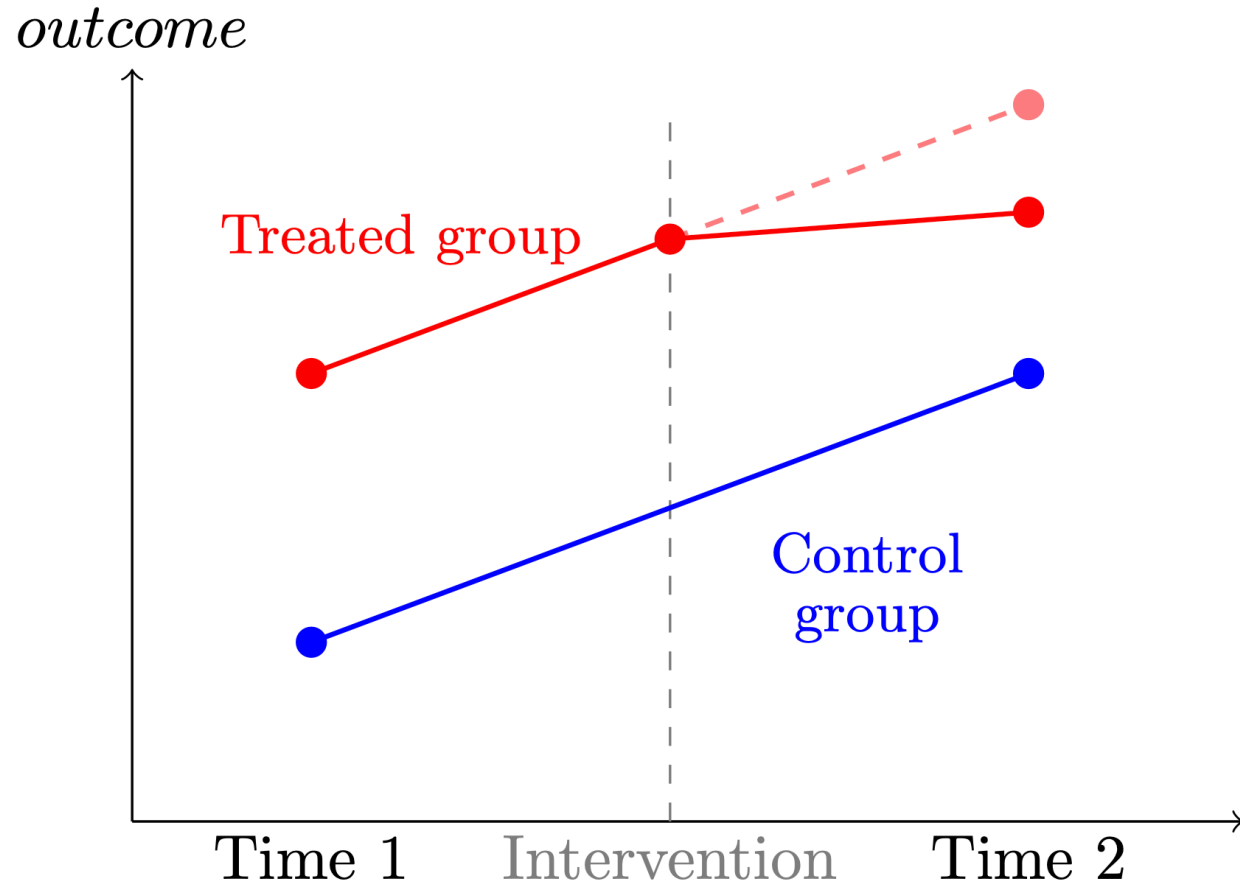


Basic Design: Difference-in-Differences

Need a *counterfactual* for treated group.

Challenges:

- Group differences
- Time trends
- Time-varying confounders
- **Staggered implementation**



Challenges with staggered adoption

- Using earlier treated groups as controls only 'works' under homogeneity.
- Early treatment effects get subtracted from the DD estimate.
- Generates poor summary estimate if there is heterogeneity.

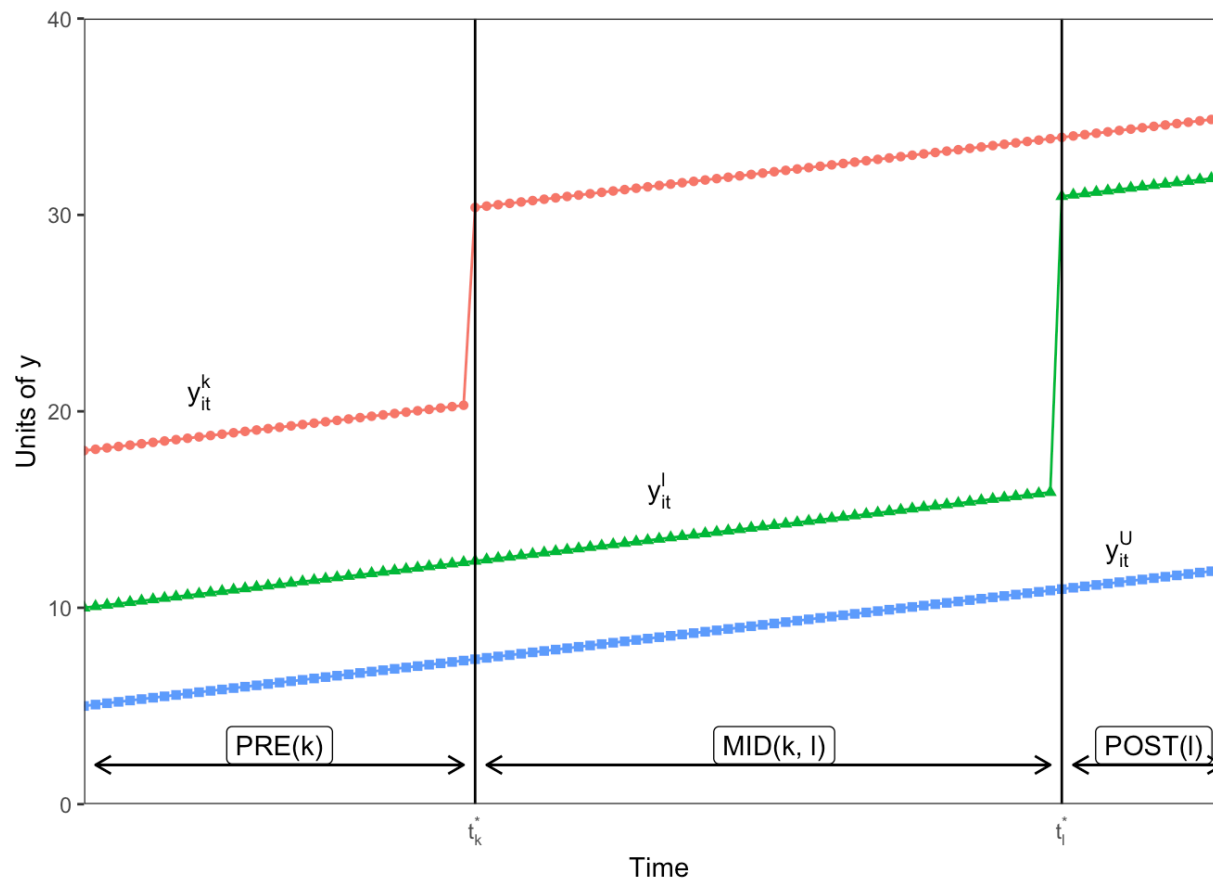
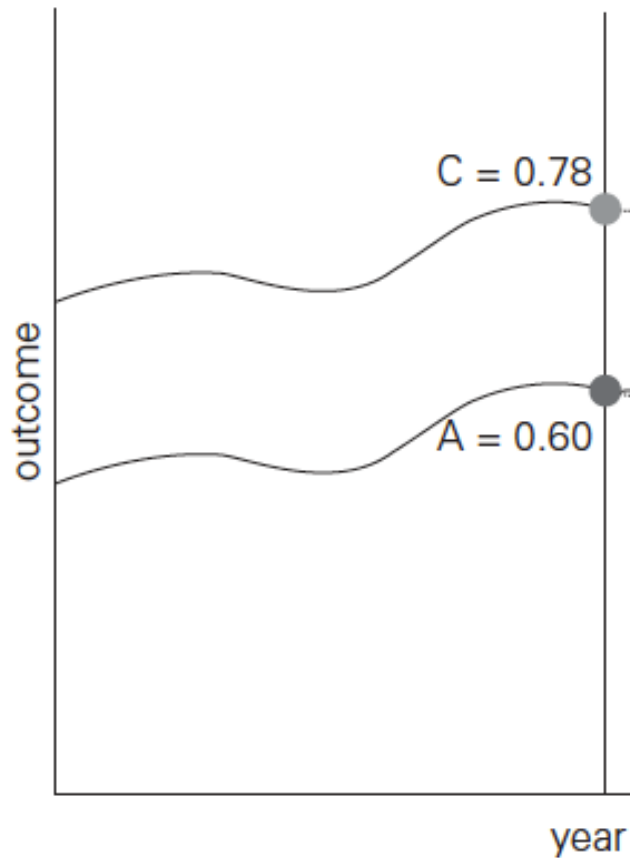


Image: [Andrew Baker](#). See also Goodman-Bacon (2021), Callaway and Sant'Anna (2021), Sun and Abraham (2021)

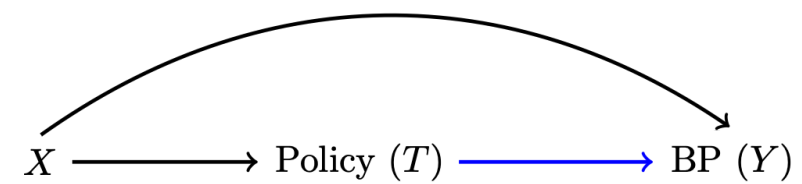
Key Assumption: Parallel Trends



- Basic DD controls for any time invariant characteristics of both treated and control groups.
- Does not control for any time-varying characteristics.
- If another policy/intervention occurs in the treated (or control) group at the same time as the intervention, we cannot cleanly identify the effect of the program.
- DD main assumption: in the absence of the intervention treated and control groups would have displayed similar trends.
- This is called the *parallel trends* assumption.

Impossible to verify, see Gertler et al. (2016).

Statistical model



Total effect via “extended” two-way fixed effects:

$$Y_{ijt} = \alpha + \sum_{r=q}^T \beta_r d_r + \sum_{s=r}^T \gamma_s f s_t + \sum_{r=q}^T \sum_{s=r}^T \tau_{rs} (d_r \times f s_t) + \mathbf{Z}_{ijt} + \varepsilon_{ijt}$$

X includes:

- d_r = treatment cohort fixed effects
- $f s_t$ = time fixed effects
- \mathbf{Z}_{ijt} = time-varying covariates

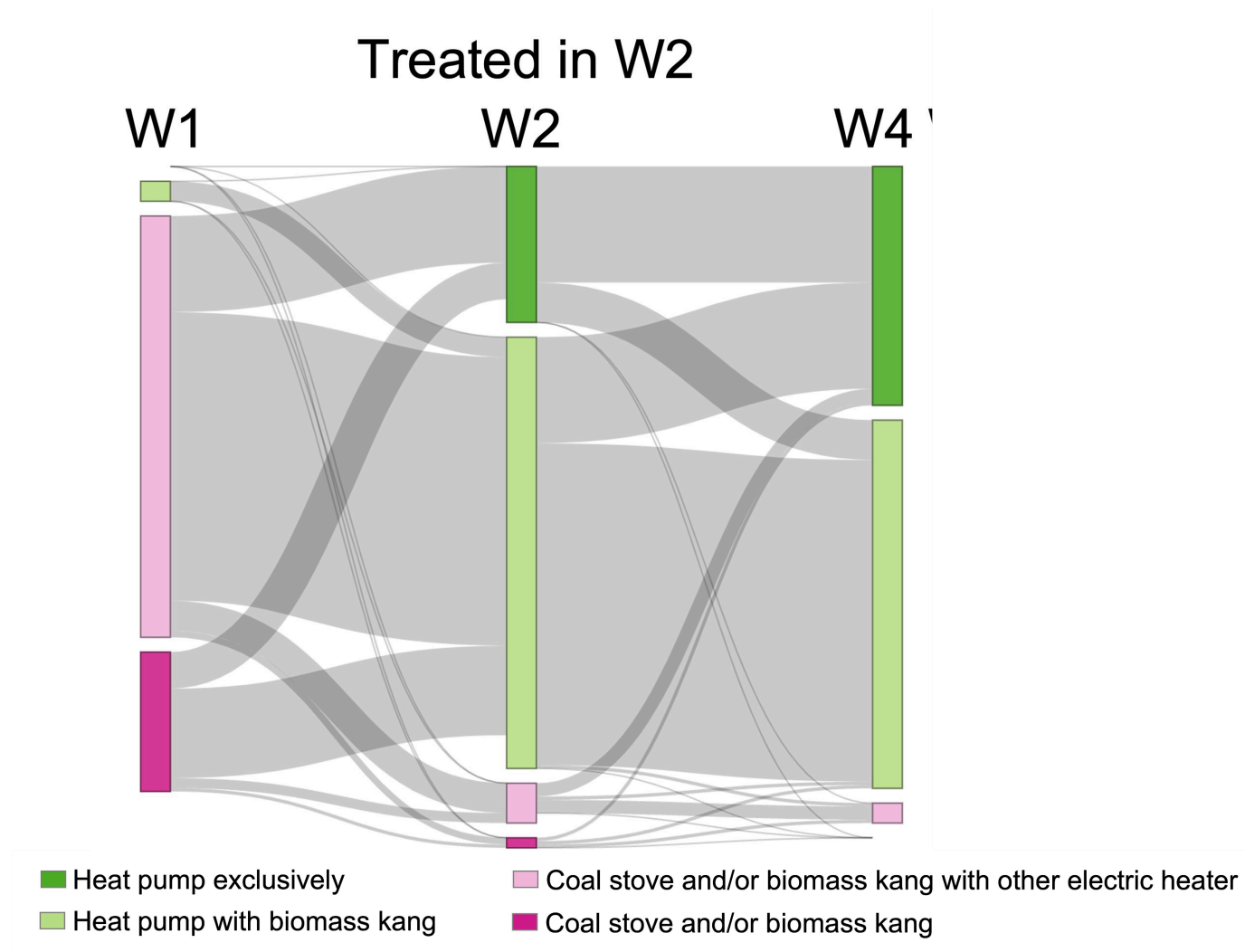
TE is average of marginal *ATTs* τ_{rs} , averaged over cohort and time.

What Did We Find?

Treatment groups were generally balanced

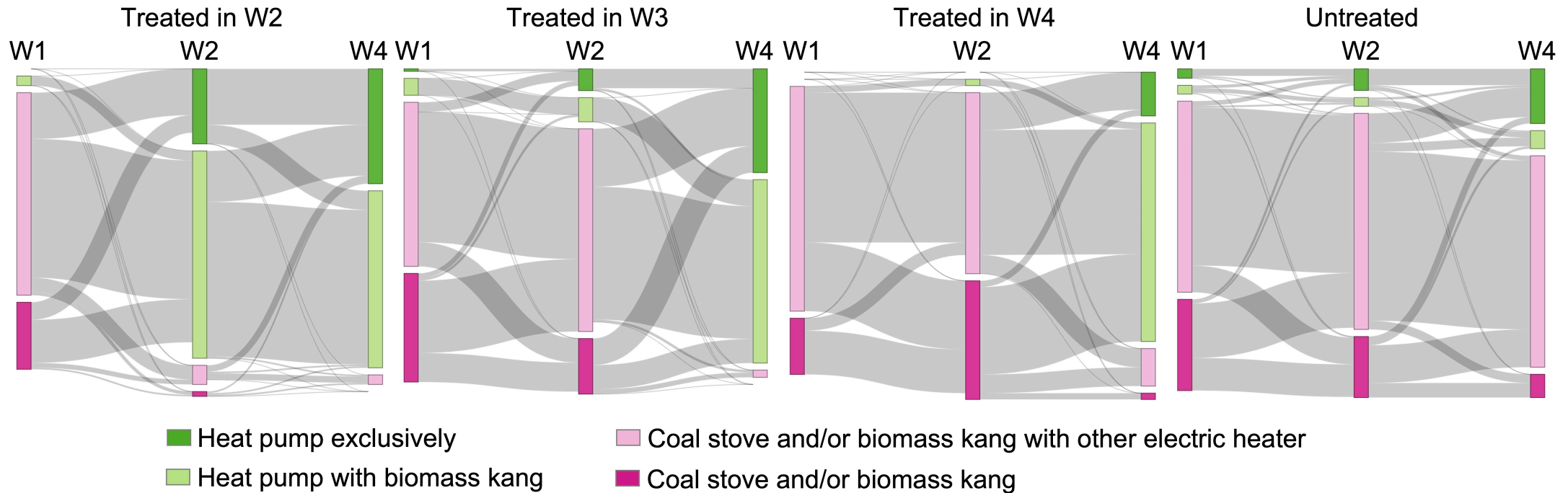
| | Never treated (N=603) | | Ever treated (N=400) | | Diff | SE |
|-------------------------------------------------|-----------------------|-------|----------------------|-------|-------|------|
| | Mean | SD | Mean | SD | | |
| Age (years) | 59.9 | 9.4 | 60.4 | 9.2 | 0.5 | 0.6 |
| Female (%) | 59.5 | 49.1 | 60.0 | 49.1 | 0.5 | 3.2 |
| Secondary+ education (%) | 12.6 | 33.2 | 9.8 | 29.7 | -2.9 | 2.0 |
| Wealth index (bottom 25%) | 26.9 | 44.4 | 22.3 | 41.7 | -4.6 | 2.8 |
| Current smoker (%) | 26.2 | 44.0 | 25.4 | 43.6 | -0.8 | 2.8 |
| Daily drinker (%) | 17.8 | 38.3 | 21.9 | 41.4 | 4.1 | 2.6 |
| Systolic (mmHg) | 131.4 | 16.8 | 128.7 | 14.3 | -2.7 | 1.0 |
| Diastolic (mmHg) | 82.7 | 11.6 | 82.1 | 11.3 | -0.6 | 0.8 |
| Body mass index (kg/m ²) | 26.3 | 3.7 | 25.8 | 3.6 | -0.5 | 0.3 |
| Any respiratory problem (%) | 50.6 | 50.0 | 54.3 | 49.9 | 3.7 | 3.2 |
| Temperature (°C) | 13.8 | 3.6 | 13.5 | 3.3 | -0.3 | 0.2 |
| Personal PM _{2.5} (ug/m ³) | 127.1 | 145.3 | 102.3 | 105.5 | -24.7 | 11.9 |

Treated households adopted cleaner energy

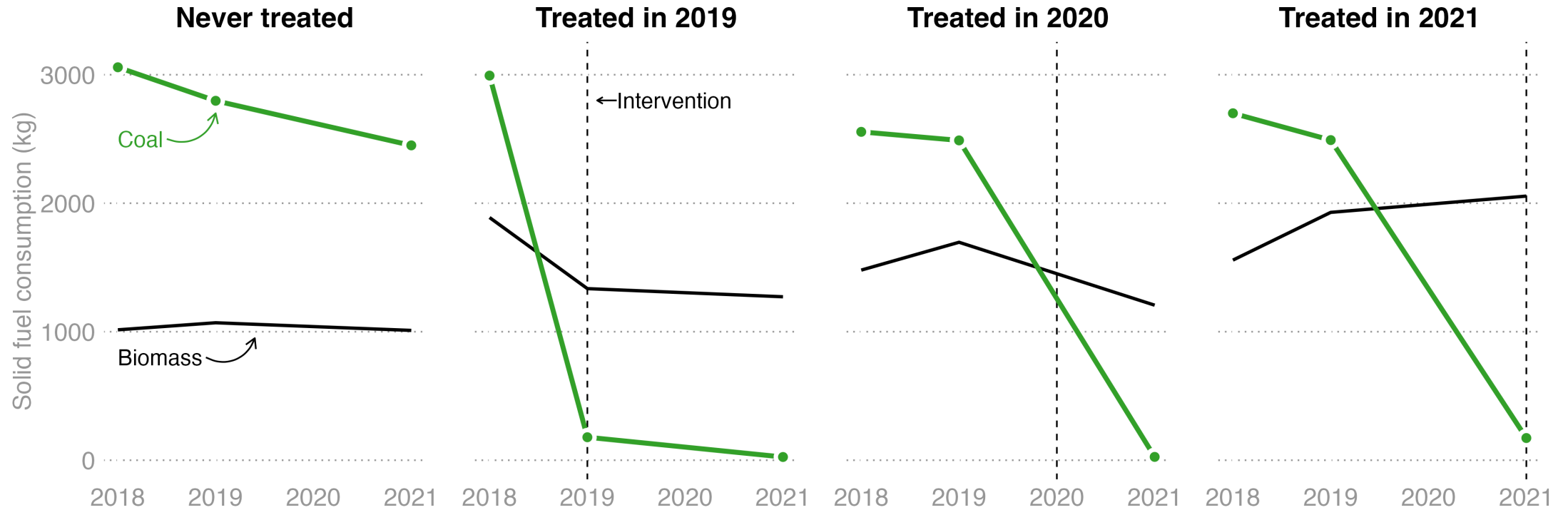


Treated households adopted cleaner energy

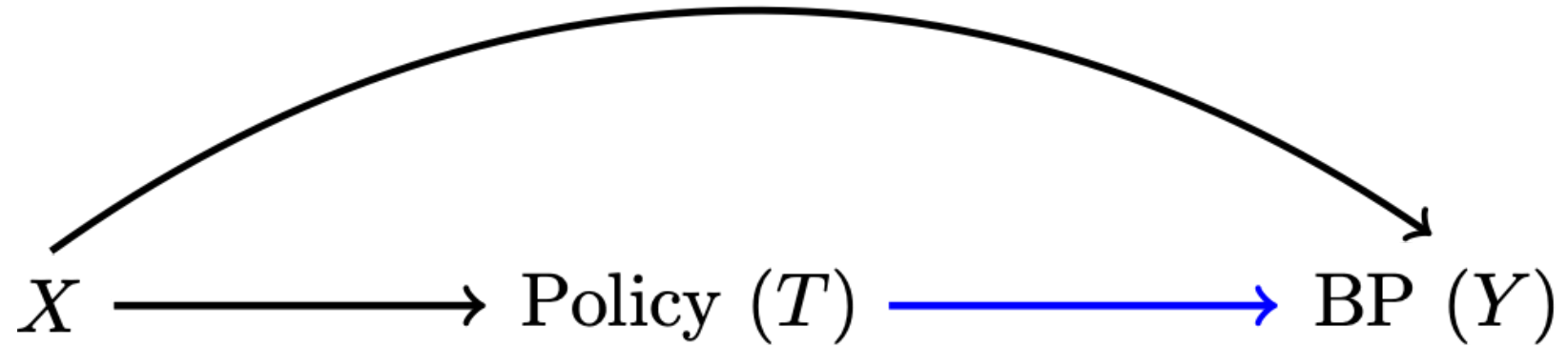
At the time of treatment



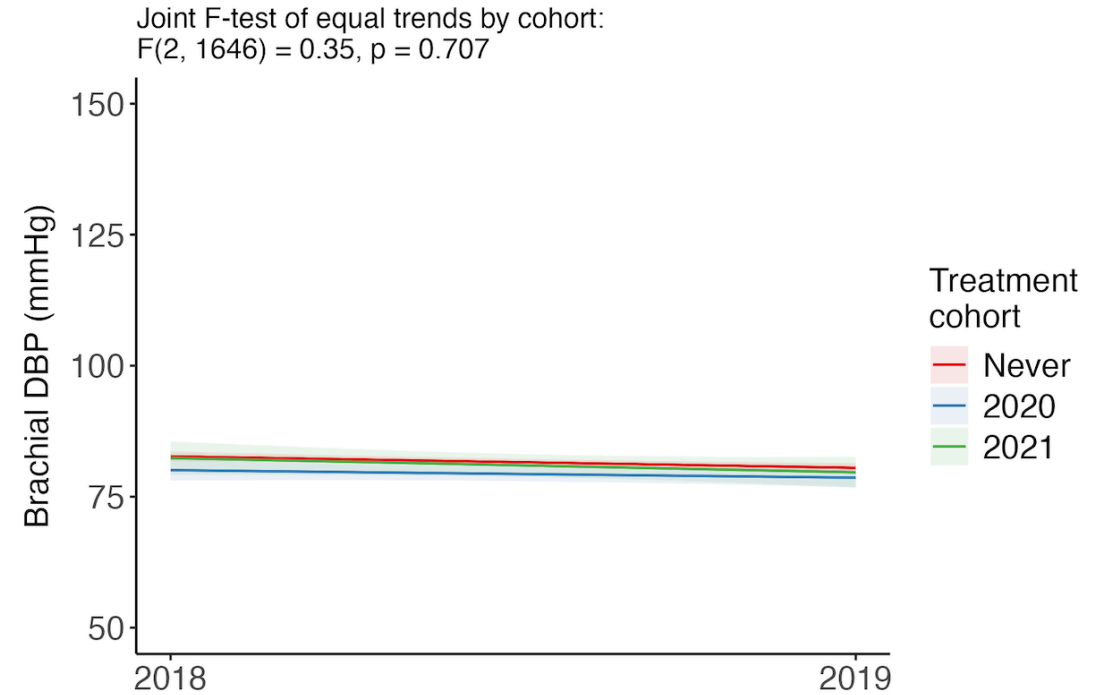
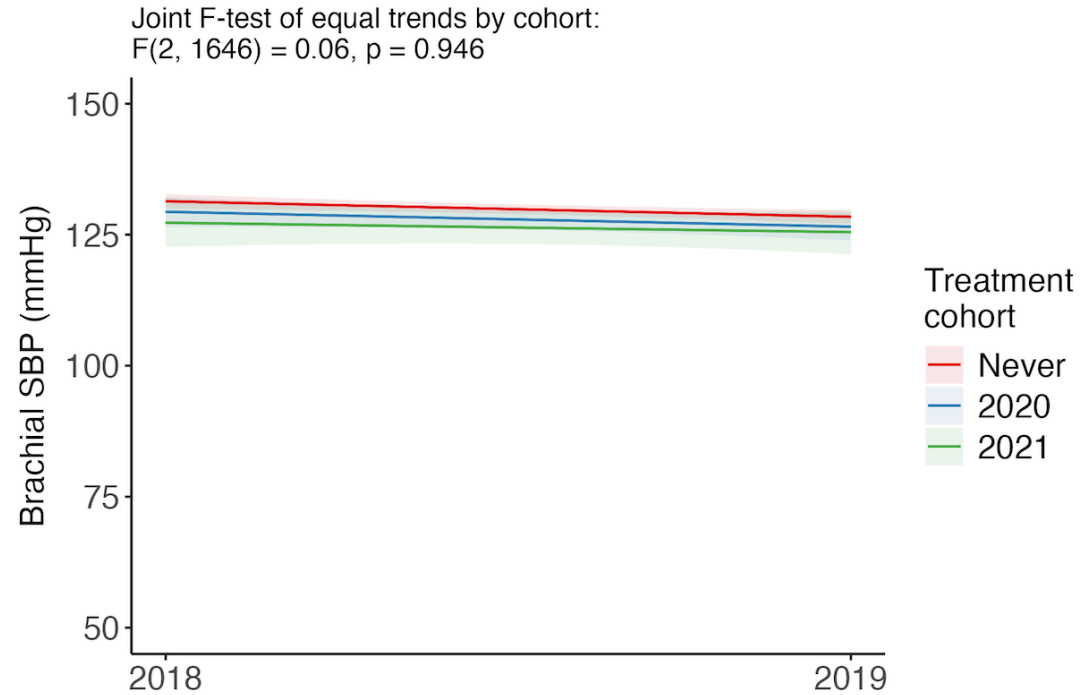
Treated households reported less coal use



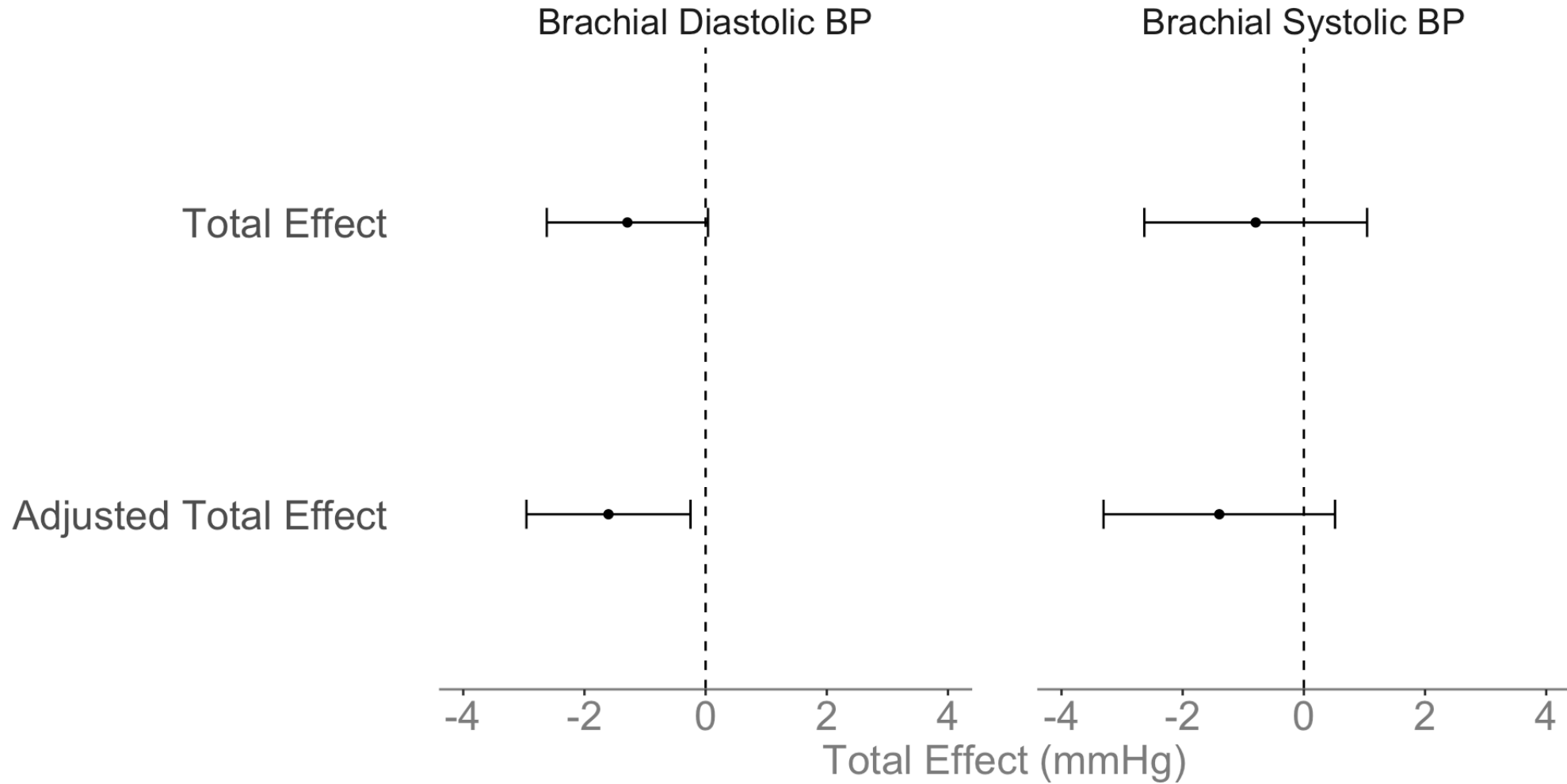
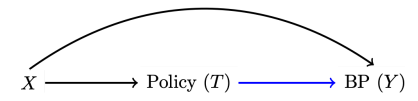
Did the policy affect outcomes?



Evidence of parallel pre-trends for BP

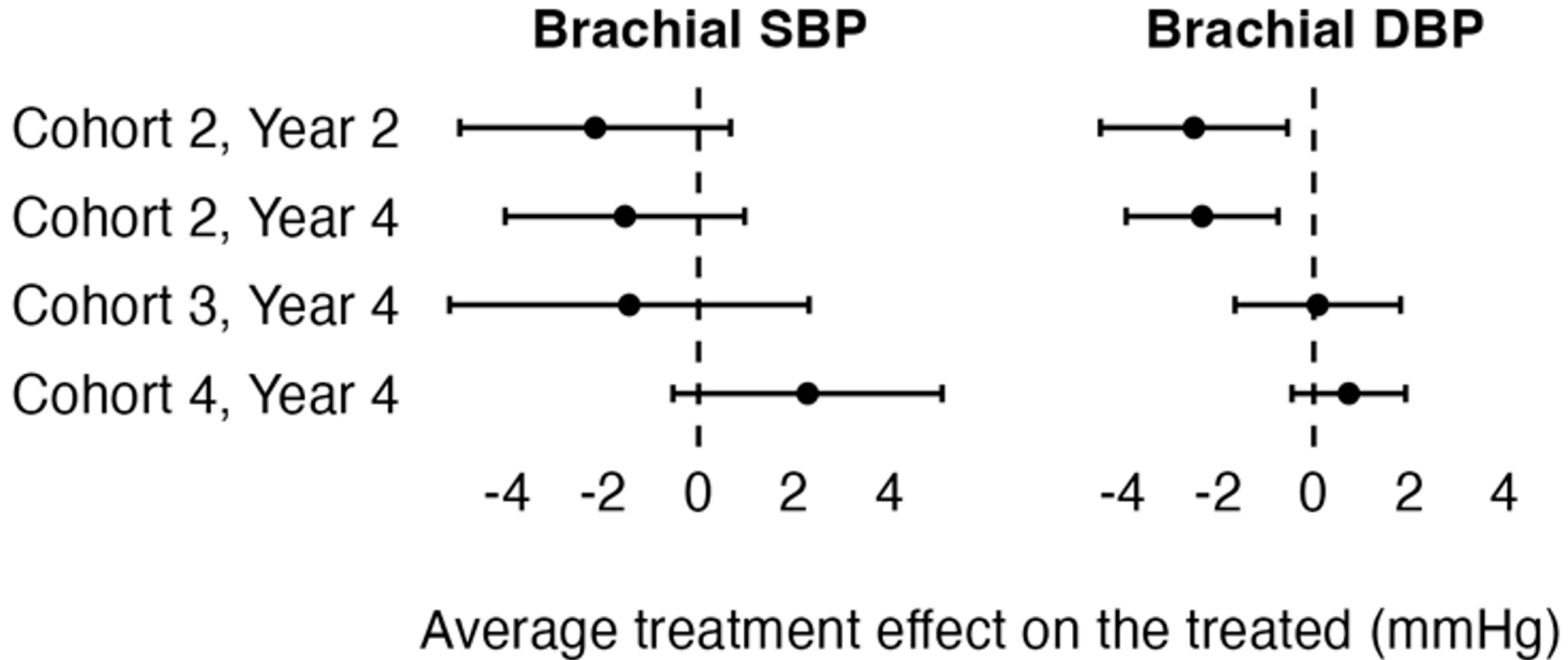


Impact on blood pressure



Time-varying covariates: age, sex, waist circumference, smoking, alcohol consumption, and use of blood pressure medication.

Some evidence of heterogeneity

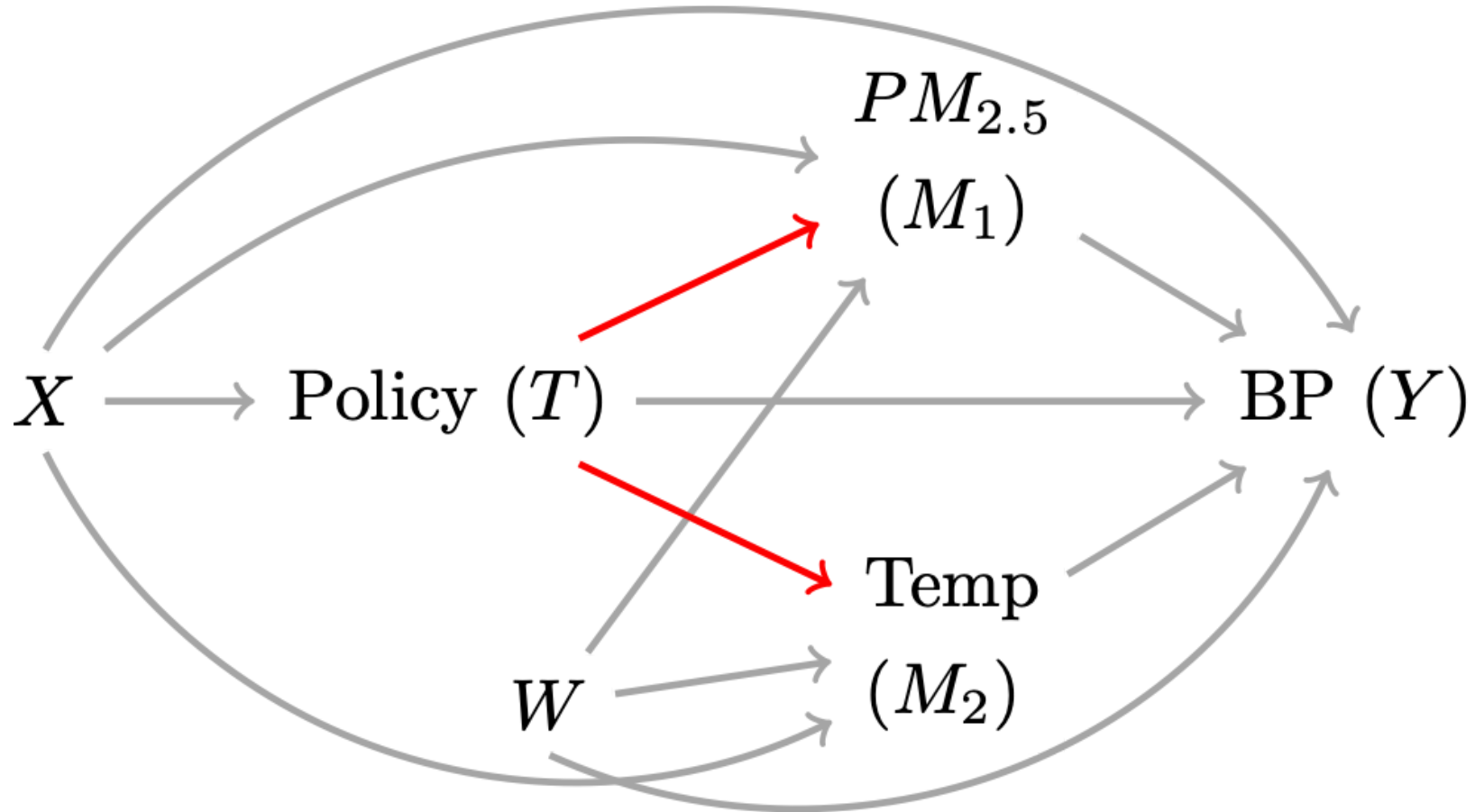


Reductions in some self-reported respiratory symptoms.

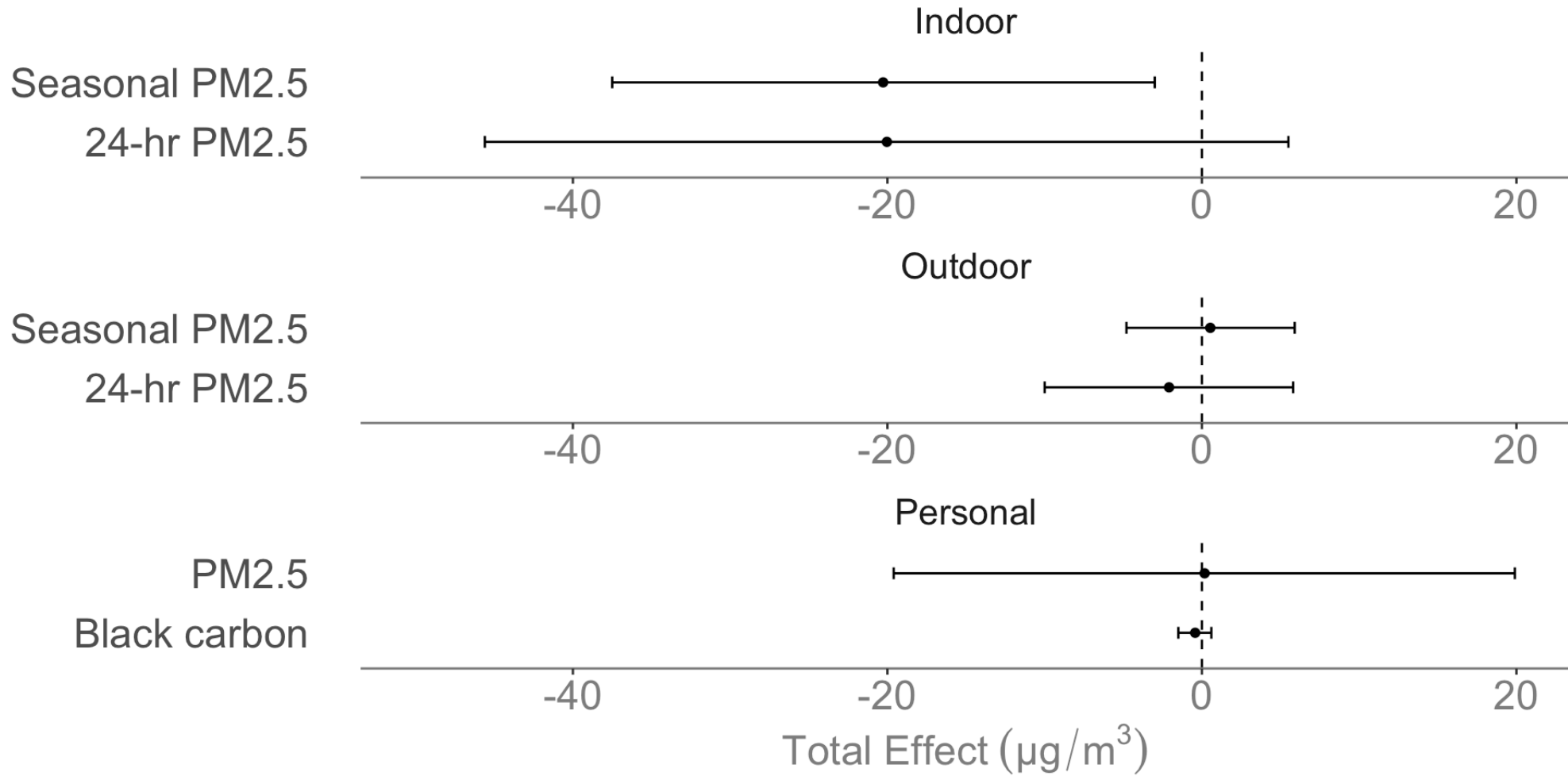
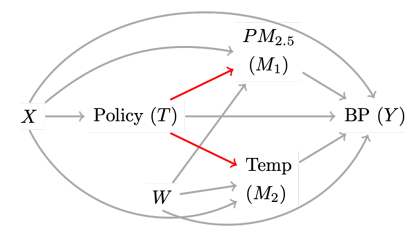
Little evidence of impact on inflammatory markers.

| | | Obs | ATT | (95% CI) |
|-----------------------------|-------------------|------|------|---------------|
| Respiratory outcomes | | | | |
| Self-reported (pp) | Any symptom | 3076 | -7.5 | (-12.7, -2.3) |
| | Coughing | 3076 | -2.7 | (-7.1, 1.7) |
| | Phlegm | 3076 | -1.6 | (-5.6, 2.4) |
| | Wheezing attacks | 3076 | 1.0 | (-1.9, 3.9) |
| | Trouble breathing | 3076 | -3.4 | (-9.2, 2.4) |
| | Chest trouble | 3076 | -3.4 | (-8.1, 1.3) |
| Measured | FeNO (ppb) | 793 | 0.3 | (-2.2, 2.8) |
| Inflammatory markers | | | | |
| Measured | IL6 (pg/mL) | 1603 | 0.8 | (-0.3, 2.0) |
| | TNF-alpha (pg/mL) | 1603 | 0.8 | (-0.1, 1.7) |
| | CRP (mg/L) | 1603 | 0.1 | (-0.5, 0.6) |
| | MDA (μM) | 1603 | 0.2 | (-0.2, 0.6) |

Did the policy affect the mediators?

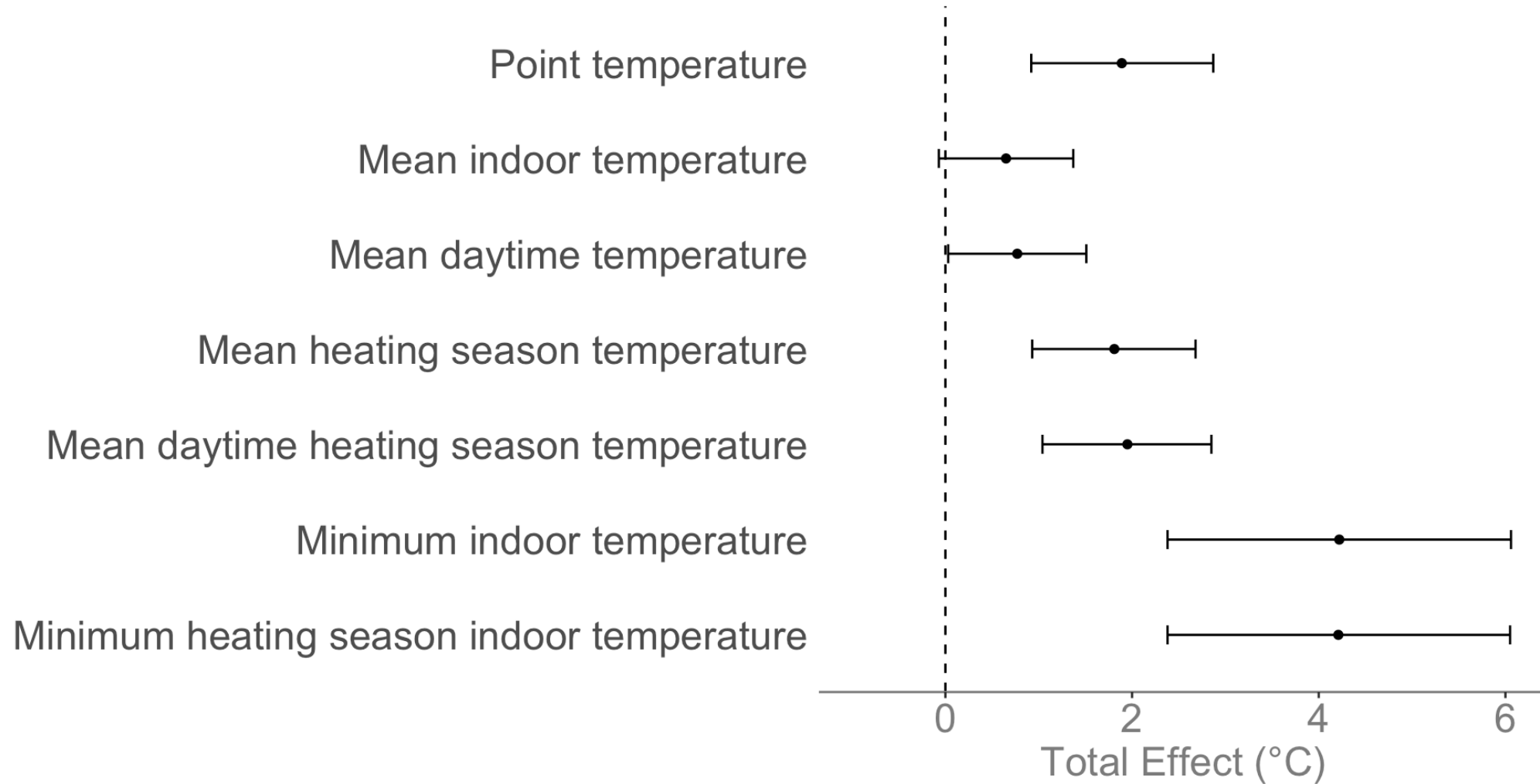
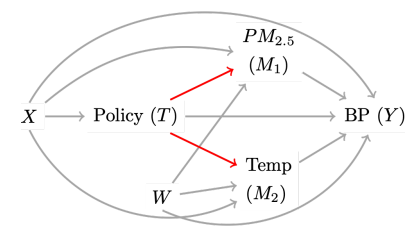


Policy reduced (only) indoor PM



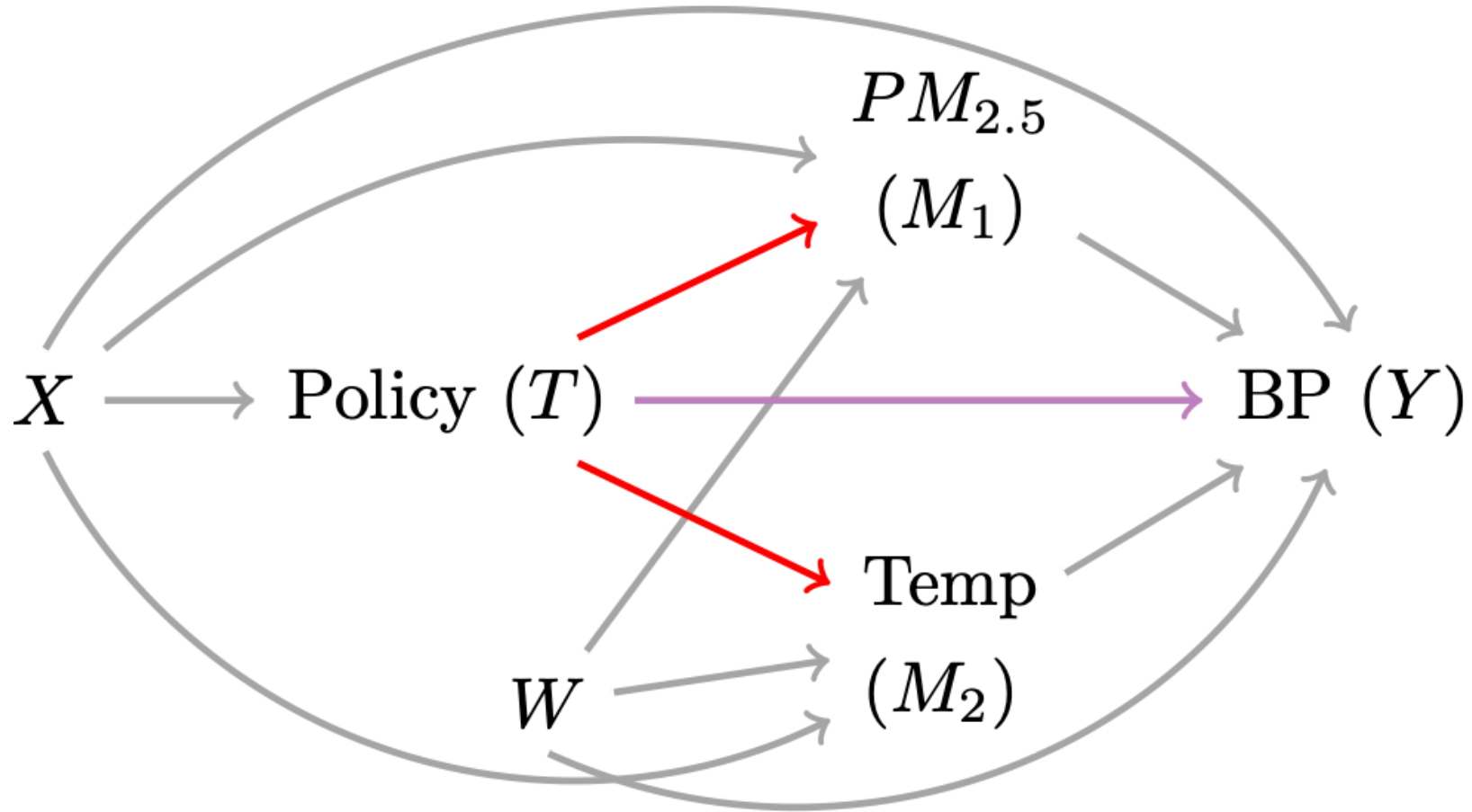
ETWFE models adjusted for household size, smoking, outdoor temperature, and outdoor dewpoint.

Policy increased indoor temperature

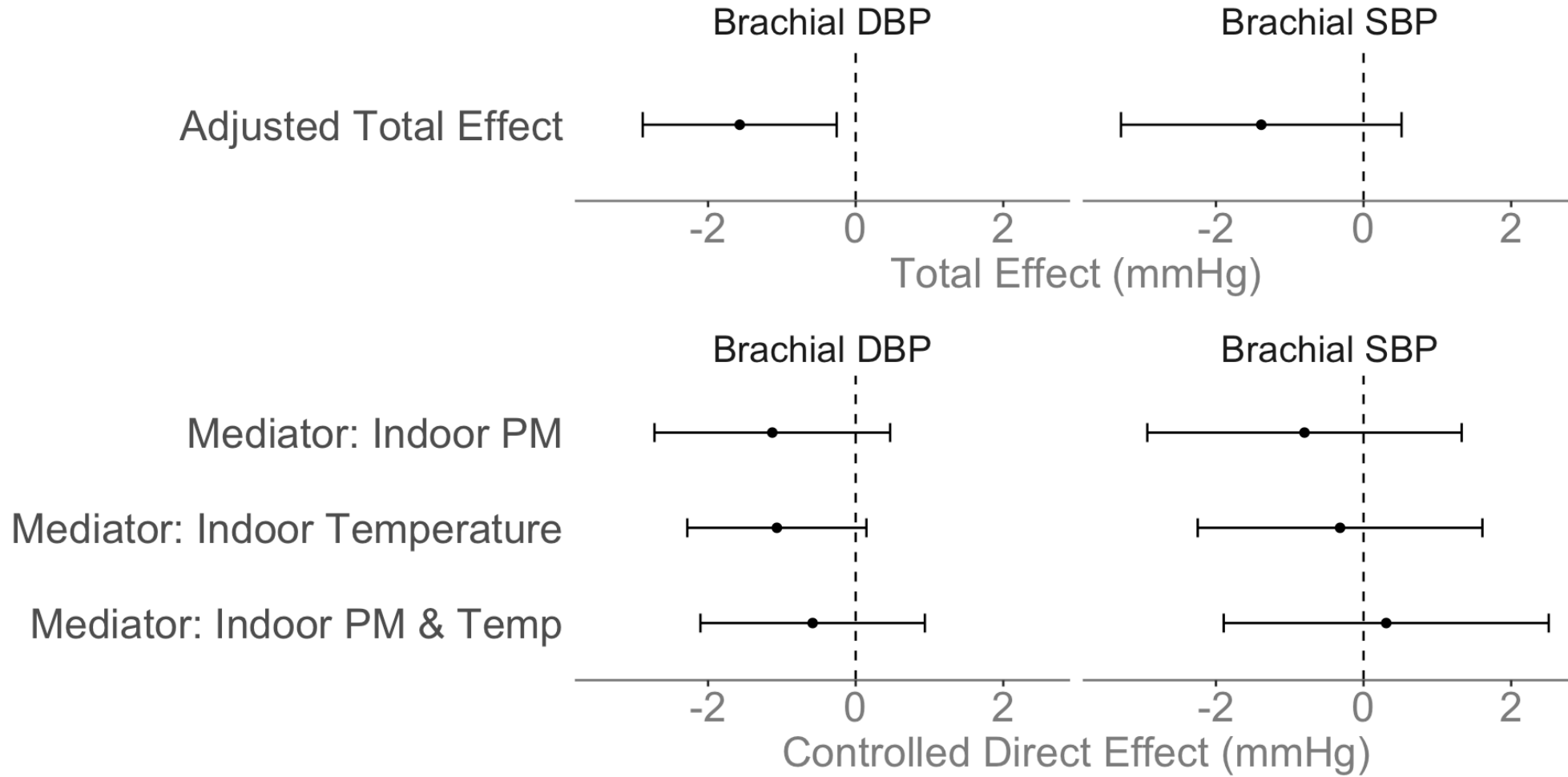
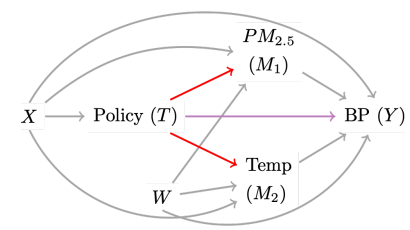


ETWFE models adjusted for the number of rooms and wintertime occupants in the household, age of the primary respondent, and wealth index.

Do $PM_{2.5}$ and temperature mediate the BP effect?

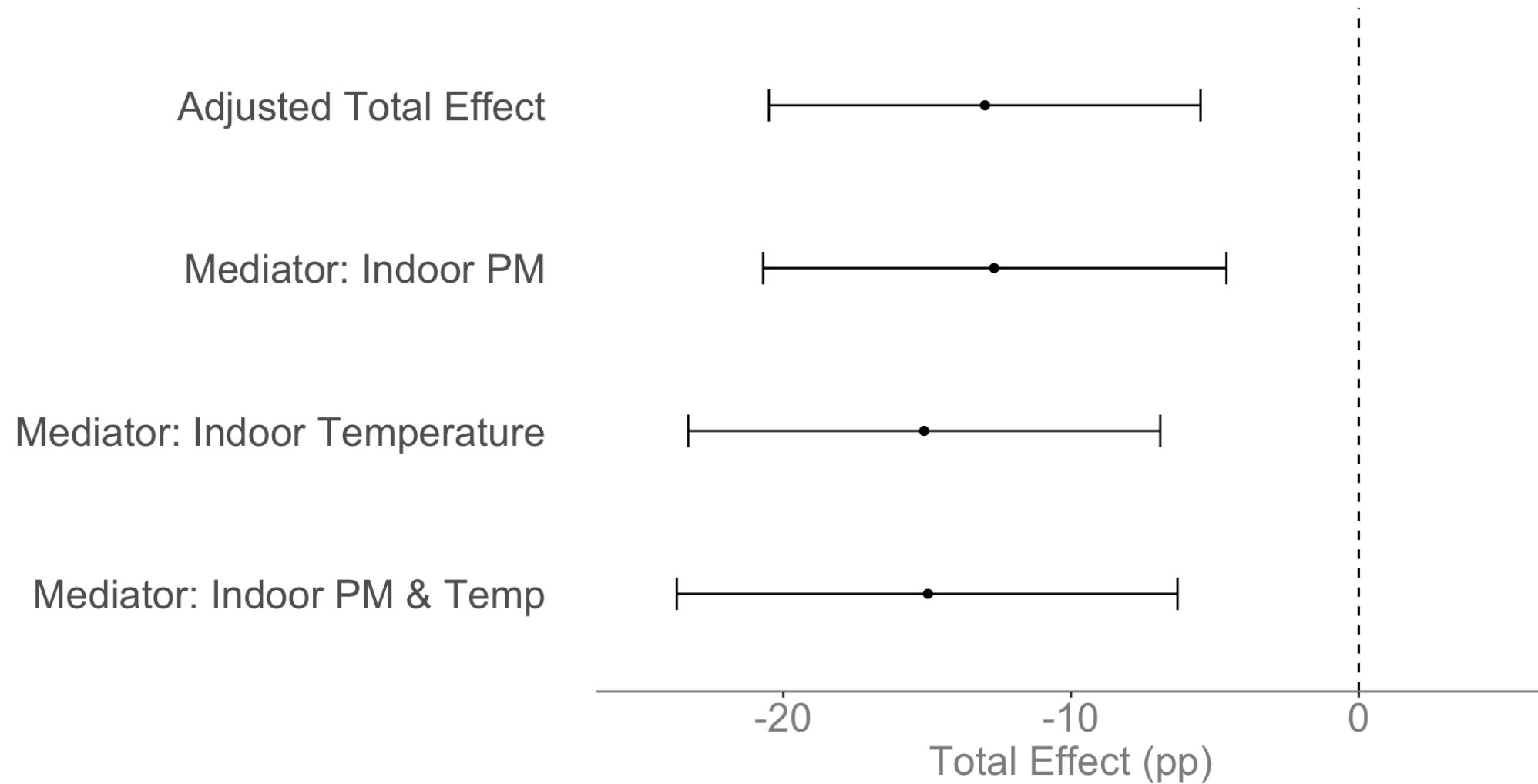


BP mostly mediated by $PM_{2.5}$ and temp



ETWFE model with exposure-mediator interaction, adjusted for time-varying covariates.

Little mediation for respiratory symptoms



What Does It Mean?

Uptake

- High uptake and consistent use of the new heat pump technology.
- Persistent effects for early treated villages.
- Large reductions in coal use in treated villages.



Impacts

Air pollution

- Impacts on indoor $PM_{2.5}$ but not personal exposures or outdoor $PM_{2.5}$
- Secular trends affected by large-scale policy changes
- Movement between indoor and outdoor

Health outcomes

- Overall lower BP, some evidence of heterogeneity
- Improvements in respiratory symptoms
- BP impacts largely mediated by $PM_{2.5}$ and temperature



Questions?

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