How Do Household Energy Transitions Work?

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2024-01-05

Table of contents

Abstract

Brief summary of what we did.

Introduction

China is deploying an ambitious plan to transition up to 70% of all households in northern China to clean space heating, including Beijing. To meet this target the Beijing municipal

government announced a two-pronged program that designates coal-restricted areas and simultaneously offers subsidies to night-time electricity rates and for the purchase and installation of electric-powered, air-source heat pumps to replace traditional coal-heating stoves. The program is being rolled out on a village-by-village basis; however there is uncertainty as to when villages will receive the program. The variability in when the policy is applied to each village allows us to treat the roll-out of the program as a quasi-randomized intervention. Households may also be differentially affected by this program due to factors such as financial constraints, preferences and social capital, and there is uncertainty about whether and how this intervention may affect indoor and outdoor air pollution, as well as health behaviors and health outcomes.

Specific Aims and Overarching Approach

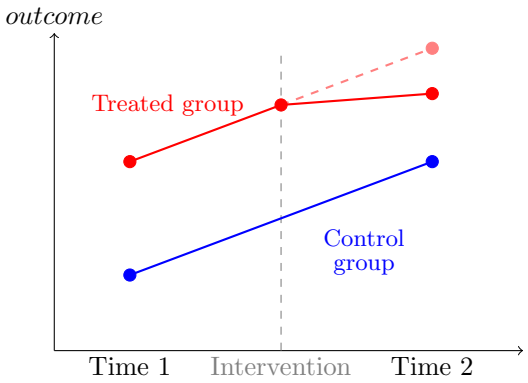
This study builds on three data collection campaigns in winter 2018/19, winter 2019/20, and winter 2021/22, as well as a partial campaign in winter 2020/21 (CIHR-funded) with the following specific aims:

1. Estimate how much of the policy's overall effect on health, including respiratory symptoms and cardiovascular outcomes (blood pressure, central hemodynamics, blood inflammatory and oxidative stress markers), can be attributed to its impact on changes in PM2.5;
2. Quantify the impact of the policy on outdoor air quality and personal air pollution exposures, and specifically the source contribution from household coal burning (Previously Aim 3);
3. Quantify the contribution of changes in the chemical composition of PM2.5 from different sources to the overall effect on health outcomes (Previously Aim 2).

Study Design and Methods

- Field equipment
- DiD schematic
- Mediation DAG

To understand how Beijing's policy works we used a difference-in-differences (DiD) design (Callaway 2020), leveraging the staggered rollout of the policy across multiple villages to estimate its impact on health outcomes and understand the mechanisms through which it works.



The DiD design compares outcomes before and after an intervention in a treated group relative to the same outcomes measured in a control group. The control group trend provides the crucial "counterfactual" estimate of what would have happened in the treated group had it not been treated. By comparing each group to itself, this approach helps to control for both measured and unmeasured fixed differences between the treated and control groups. By measuring changes over time in outcomes in the control group unaffected by the treatment, this approach also controls for any unmeasured factors affecting outcome trends in both treated and control groups. This is important since there are often many potential factors affecting outcome trends that cannot be disentangled from the policy if one only studies the treated group (as in a traditional pre-post design).

Data Analysis

Results

Description of study sample (Table)

- Study flowchart of participants (Figure)
- Description of PM measurements (Figure)
- Uptake of the policy (Sankey energy use Figure)
- Impact of 'treatment assignment' on coal use (Figure? Table?)

Aim 1

- Impact of policy on PM mass (Figure)
- Table of CDEs (Central SBP, Central DBP, FeNO, Respiratory outcomes, inflammatory markers), mediated by indoor PM (CDEs for personal and outdoor in SI)
- Table for multiple mediation analysis for BP

Aim 2 (was Aim3)

- Figure of source contributions (6 or fewer components)
- Source contributions by treatment status
- DiD for source contributions to PM

Aim 3

- Table of mediated health effects by source contribution (coal and biomass)

Discussion and Conclusions

Other relevant results (Tables or figures in SI) - Temperature - Heating room - Well-being

Implications of Findings

To come...

Data Availability Statement

To come...

Acknowledgements

To come...

References

Callaway B. 2020. Difference-in-Differences for Policy Evaluation. In: *Handbook of Labor, Human Resources and Population Economics* (K.F. Zimmermann, ed). Springer International Publishing:Cham. 1–61.

Li X, Baumgartner J, Barrington-Leigh C, Harper S, Robinson B, Shen G, et al. 2022a. Socioeconomic and Demographic Associations with Wintertime Air Pollution Exposures at Household, Community, and District Scales in Rural Beijing, China. Environmental Science & Technology 56:8308–8318; doi:10.1021/acs.est.1c07402.

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Sternbach TJ, Harper S, Li X, Zhang X, Carter E, Zhang Y, et al. 2022. Effects of indoor and outdoor temperatures on blood pressure and central hemodynamics in a wintertime longitudinal study of Chinese adults. Journal of Hypertension 40:1950–1959; doi:10.1097/HJH.0000000000003198.

Appendices

About the authors

Other publications

Other papers that have been published.(Li et al. 2022a; Li et al. 2022b; Sternbach et al. 2022)