How Do Household Energy Transitions Work?

Jill Baumgartner (Co-PI) Sam Harper (Co-PI)
On behalf of the Beijing Household Energy Transitions Team

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1 Introduction

China is deploying an ambitious policy to transition up to 70% of households in northern China from residential coal heating to electric or gas "clean" space heating, including a large-scale roll out across rural and peri-urban Beijing, referred to in this document as China's Coal Ban and Heat Pump (CBHP) subsidy policy. 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 heat pumps to replace traditional coal-heating stoves. The policy was piloted in 2015 and, starting in 2016, was rolled out on a village-by-village basis. The variability in when the policy was applied to each village allowed us to treat the roll-out of the program as a quasi-randomized intervention and evaluate its impacts on air quality and health. Household air pollution is a well-established risk factor for adverse health outcomes over the entire lifecourse, yet there is no consensus that clean energy interventions can improve these health outcomes based on evidence from randomized trials (Lai et al. 2024). Households may be differentially affected by the CBHP due to factors such as financial constraints and user preferences, and there is uncertainty about whether and how the policy may affect indoor and outdoor air pollution, as well as heating behaviors and health outcomes.

1.1 Subheading

1.2 Description of study sample

Table 1: Overall impacts of the 'coal-to-clean energy' policy on blood pressure, respiratory outcomes, and inflammatory markers

		Observed Results		Hypothetical Design Analysis			
		Estimate	SE	Effect	Power (%)	S-bias[a]	M-bias[b]
Blood pressure (mmHg)							
Systolic BP (mmHg)	Brachial	-1.4	1.0	-1.5	33.7	0.09	0.7
	Central	-1.6	0.9	-1.5	35.9	0.08	0.7
Diastolic BP (mmHg)	Brachial	-1.6	0.7	-1.0	30.4	0.00	1.8
	Central	-1.7	0.7	-1.0	32.0	0.00	1.8
Pulse Pressure	Brachial	0.2	0.6	0.5	12.9	0.23	1.0
	Central	0.1	0.6	0.5	14.4	0.22	1.0
BP Amplification x10	Pulse pressure	0.0	0.6	0.1	5.3	0.44	4.5
	Systolic BP	0.1	0.2	0.1	10.0	0.29	1.2
Respiratory outcomes							
Self-reported (pp)	Any symptom	-8.1	2.7	-5.0	47.0	0.00	1.4
	Coughing	-3.0	2.3	-2.0	14.0	0.22	1.0
	Phlegm	-2.1	2.1	-3.0	29.9	0.10	0.7
	Wheezing attacks	0.8	1.5	-1.0	10.1	0.28	1.2
	Trouble breathing	-3.8	2.9	-3.0	18.2	0.18	0.9
	Chest trouble	-3.9	2.4	-1.0	7.0	0.36	1.8
Measured	FeNO (ppb)	0.6	1.3	-0.5	6.6	0.37	2.0
Inflammatory markers (%)							
Measured (%)	IL6	5.9	11.2	-2.0	5.4	0.43	4.1
	TNF-alpha	24.7	14.1	-2.0	5.2	0.45	5.0
	CRP	3.8	13.5	-2.0	5.3	0.45	4.9
	MDA	6.5	9.0	-2.0	5.6	0.41	3.3

Note: BP = Blood Pressure, pp = percentage points, ppb = parts per billion, SE = Standard Error

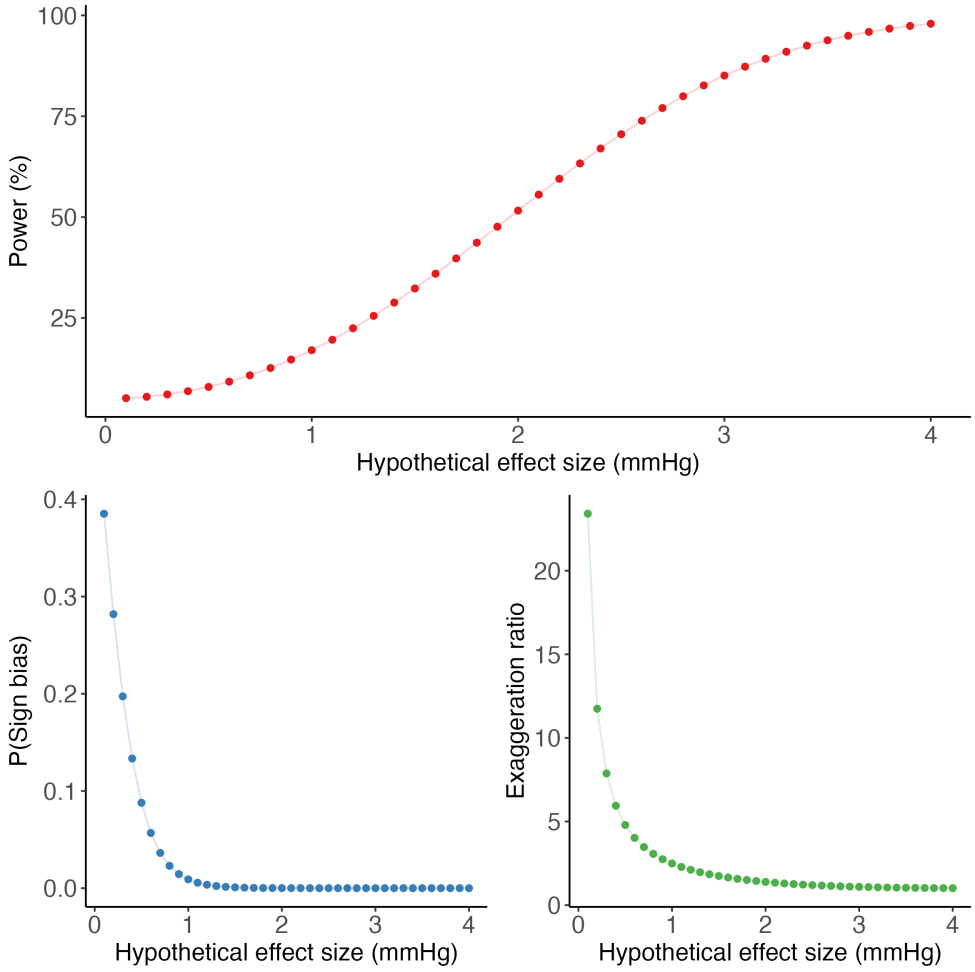
[a] Assuming the true effect size and our study design and sample size, the probability that an observed estimate will have the wrong sign.

[b] Assuming the true effect size and our study design and sample size, the ratio by which an observed estimate will exaggerate the true effect.

1.2.1 Blood pressure

Figure 1 show the range of estimates for power, sign-bias, and effect exaggeration for several hypothetical effect sizes for the impact of the program on blood pressure, conditional on our study design and sample size (standard error of 1 mmHg).

Figure 1: Power, sign-bias, and exaggeration ratios for various hypothetical effects of the policy on blood pressure, given our study design.



Lai PS, Lam NL, Gallery B, Lee AG, Adair-Rohani H, Alexander D, et al. 2024. Household Air Pollution Interventions to Improve Health in Low- and Middle-Income Countries: An Official

American Thoracic Society Research Statement. American Journal of Respiratory and Critical Care Medicine 209:909–927; doi:10.1164/rccm.202402-0398ST.