How Do Household Energy Transitions Work?

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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

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.

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

			DiD		Adjusted DiD	
		Obs	ATT	(95% CI)	ATT[a]	(95% CI)
Blood pressure (mmHg)						
Systolic BP	Brachial	1	-0.79	(-2.63, 1.04)	-1.40	(-3.31, 0.51)
	Central	2	-1.04	(-2.82, 0.73)	-1.56	(-3.40, 0.28)
Diastolic BP	Brachial	3	-1.29	(-2.62, 0.04)	-1.60	(-2.96, -0.25)
	Central	4	-1.35	(-2.66, 0.04)	-1.66	(-2.97, -0.34)
Pulse Pressure	Brachial	5	0.50	(-0.71, 1.70)	0.21	(-1.00, 1.41)
	Central	6	0.31	(-0.85, 1.46)	0.10	(-1.01, 1.20)
BP Amplification x10	Pulse pressure	7	0.10	(-0.12, 1.40)	0.00	(-1.20, 1.20)
	Systolic BP	8	0.20	(-0.20, 0.50)	0.10	(-0.20, 0.40)
Respiratory outcomes						
Self-reported (pp)	Any symptom	3081	-7.65	(-12.76, -2.55)	-8.12	(-13.32, -2.92)
	Coughing	3081	-2.49	(-7.08, 2.10)	-2.98	(-7.48, 1.52)
	Phlegm	3081	-1.34	(-5.48, 2.80)	-2.14	(-6.25, 1.97)
	Wheezing attacks	3081	0.81	(-2.17, 3.79)	0.83	(-2.14, 3.80)
	Trouble breathing	3081	-4.26	(-9.76, 1.24)	-3.80	(-9.42, 1.82)
	Chest trouble	3081	-4.18	(-8.84, 0.48)	-3.94	(-8.61, 0.74)
Measured	FeNO (ppb)		0.17	(-2.24, 2.58)	0.55	(-2.13, 3.13)
Inflammatory markers (%)						
	IL6	1	6.80	(-12.2, 30.0)	5.90	(-13.80, 30.20)
	TNF-alpha	2	24.30	(-1.3, 56.4)	24.70	(-0.90, 54.20)
	CRP	3	2.70	(-19.8, 31.6)	3.80	(-19.40, 33.60)
	MDA	4	7.60	(-8.7, 26.9)	6.50	(-9.70, 25.5)

Note: ATT = Average Treatment Effect on the Treated, DiD = Difference-in-Differences, ETWFE = Extended Two-Way Fixed Effects, Obs = observations, pp = percentage points, ppb = parts per billion.

[a] ETWFE models for blood pressure models adjusted for age, sex, waist circumference, smoking, alcohol consumption, and use of blood pressure medication. Self-reported respiratory outcomes adjusted for age, gender, and smoking. Measured respiratory outcome (FeNO) adjusted age, gender, body mass index, frequency of drinking, tobacco smoking, and frequency of exercise, occupation, time of measurement. Inflammatory marker outcome models adjusted for age, waist circumference, occupation, wealth index quantile, frequency of drinking, tobacco smoking, and frequency of farming.