

EFFECTS OF GAS STOVETOPS ON HOUSEHOLD AIR POLLUTION IN RURAL INDIA

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PRESENTATION OUTLINE



BACKGROUND



PROJECT
OVERVIEW



POLICIES
ENACTED



POLICY
IMPACT

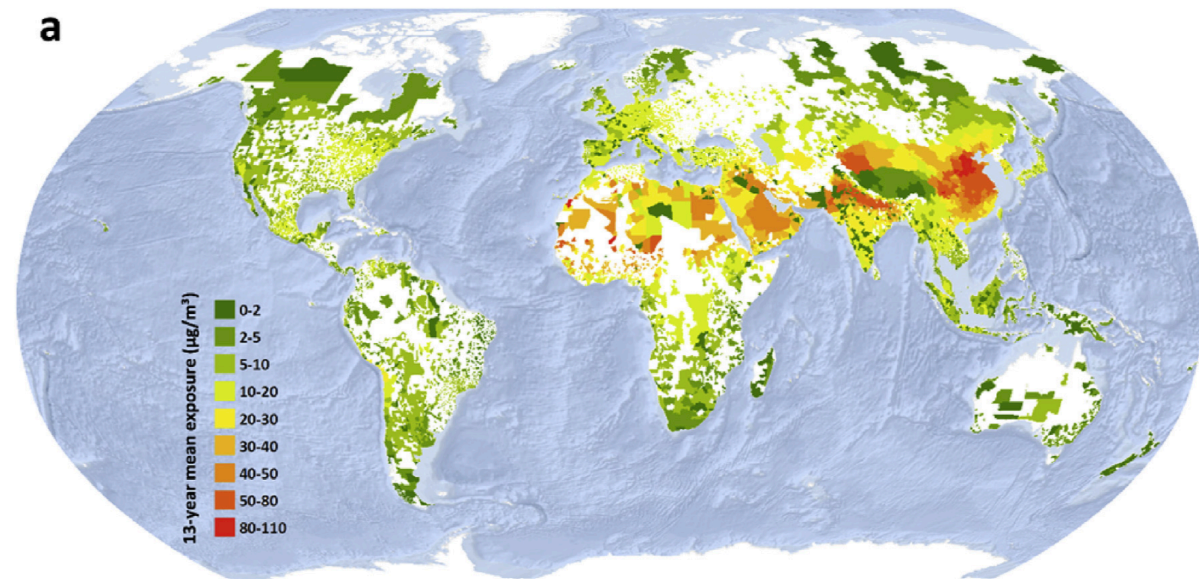


LESSONS
LEARNED

BACKGROUND: AIR POLLUTION

- The recommended air quality in the US is $35 \mu\text{g}/\text{m}^3$ compared to $40 \mu\text{g}/\text{m}^3$ in India.
- The population weighted mean exposure to ambient particulate matter $\text{PM}_{2.5}$ was $89.9 \mu\text{g}/\text{m}^3$ in 2017.

B. Chen et al. / *Environmental Pollution* 238 (2018) 874–883



BACKGROUND: AIR POLLUTION IN RURAL INDIA

- Haryana, Uttar Pradesh, and Bihar have exposure to ambient particular matter $PM_{2.5}$ measured above $125 \mu\text{g}/\text{m}^3$.
- Much of India is rural and continues to use traditional cooking methods using wood or coal as cooking fuel

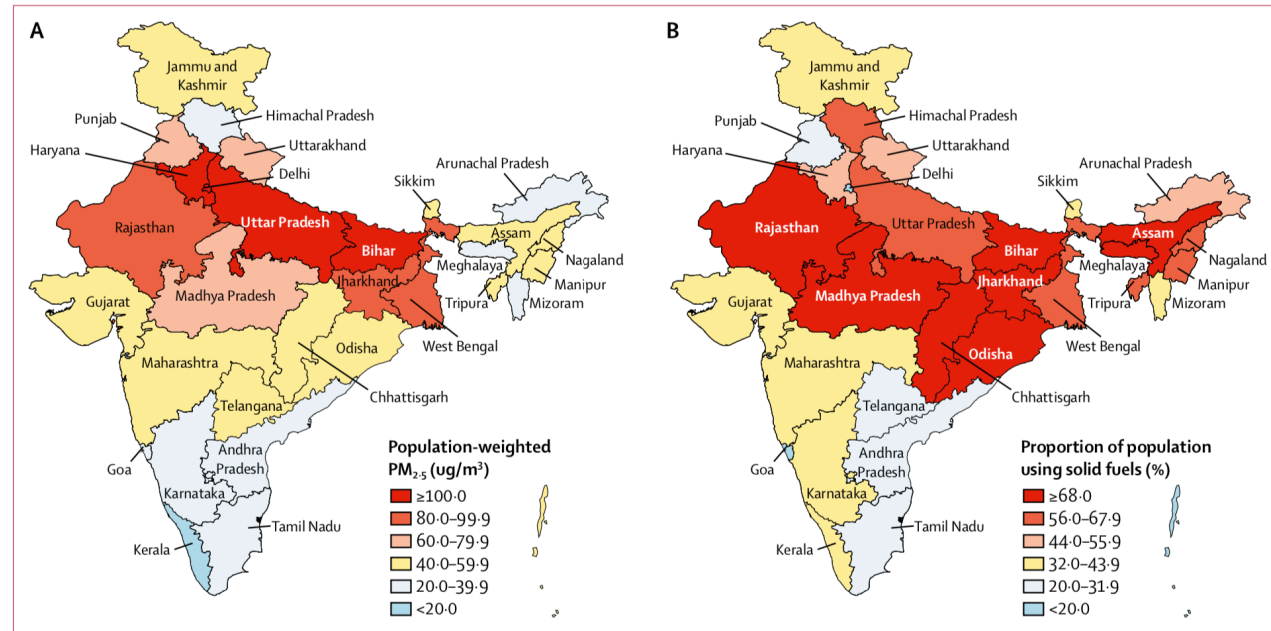


Figure 1: $PM_{2.5}$ concentration and use of solid fuels in the states of India, 2017
(A) Population-weighted mean ambient air $PM_{2.5}$ (B) Proportion of population using solid fuels.

NEGATIVE HEALTH OUTCOMES OF AIR POLLUTION

- Ambient vs. Household Air Pollution
- Health Outcomes:
 - Chronic coughs and bronchitis
 - Increased asthma attacks
 - Greater chance of cardiovascular and respiratory hospital admissions
- Women and children are affected by household air pollution at a higher proportion than men due to the larger role they play in the home



PROJECT OVERVIEW

- Overall, this project looks to analyze the health outcomes of India's rural population after various policies subsidizing liquified petroleum gas (LPG) fuel were enacted by the Indian government.

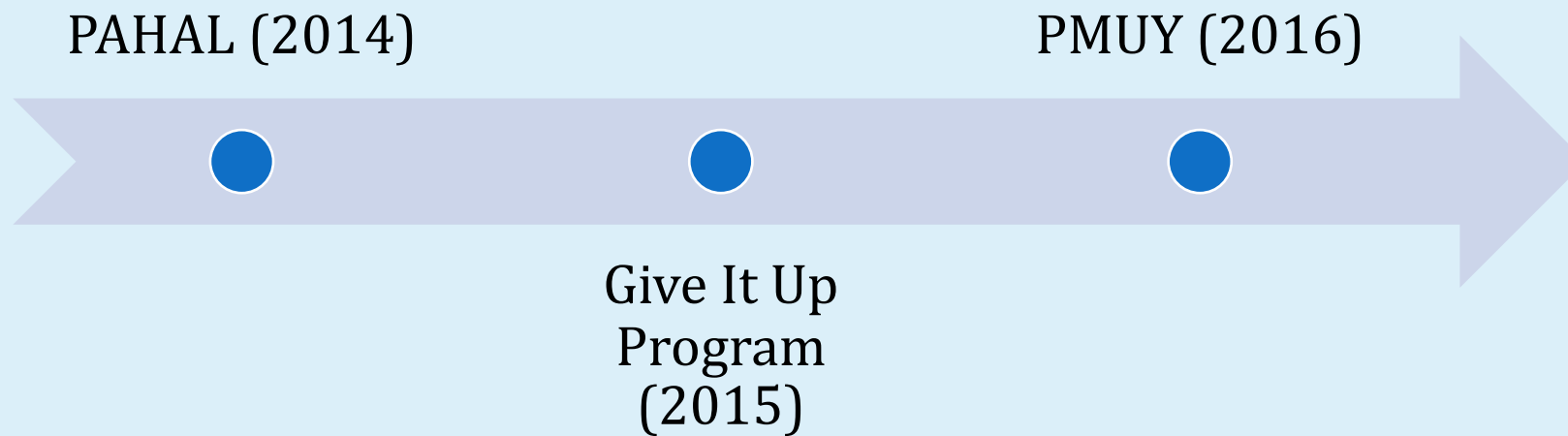


CONTEXTUALIZING FUEL TYPES AND HOUSEHOLDS

- Firewood creates a lot of pollution due to the partial combustion of the biofuel, often seen as residual smoke and soot.
- Liquefied petroleum gas (LPG) on the other hand burns a lot cleaner as there is no black carbon (soot) with it.
- Heavy rural opposition due to traditional norms



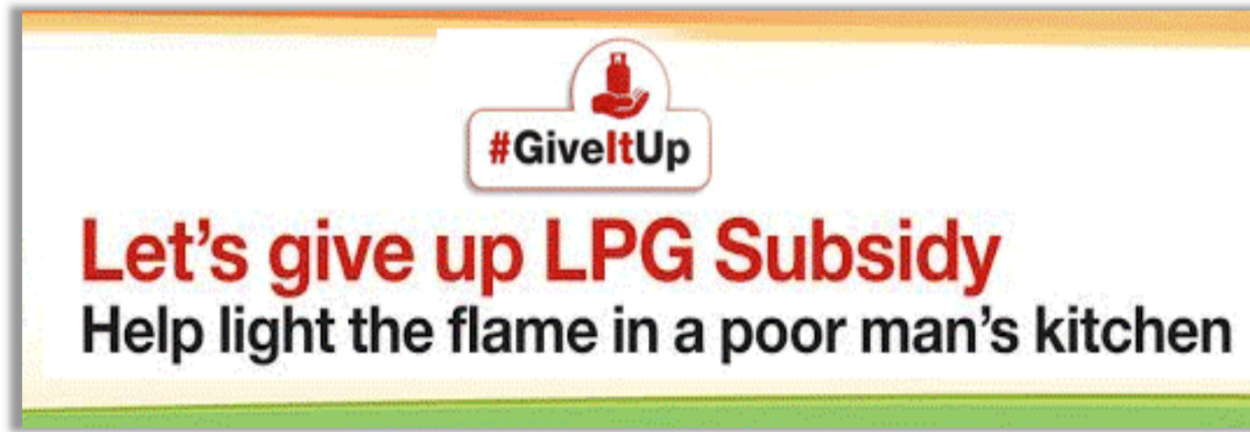
POLICY TIMELINE



POLICY: PAHAL (2014)

- Pratyaksh Hastantarit Laabh (PAHAL) - Direct Benefit Transfer of LPG
- Government subsidizes the installation of gas lines and cost of refill gas tanks for all Indian citizens
- Outcomes:
 - Increased LPG throughout all of India, but did not increase equally everywhere
 - Policy heavily favored the middle class in urban areas

POLICY: GIVE IT UP PROGRAM (2105)



Source: www.bharat-gas.in

- Policy offered affluent households the option to give up their subsidy to allow the subsidy to go to a low income household.
- In return, the affluent household would have their family name placed on a national honor roll

POLICY: PMUY (2016)

- Pradhan Mantri **Ujjwala Program** (PMUY) looked to bridge the inequity gaps and focus its subsidies for poor rural households in northern states.
- Outcomes:
 - Increased new participates and gas lines to rural households
 - Brought awareness to the rural communities of the positive health effects of LPGs

POLICY EFFECTIVENESS

Figure 13. LPG Usage Based on Household Head Sex

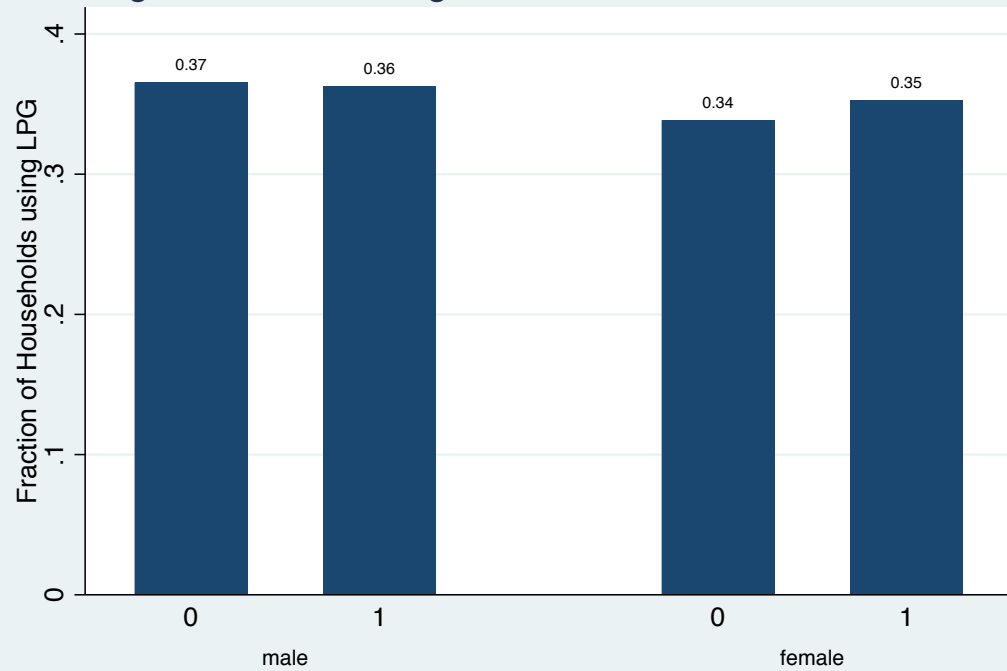
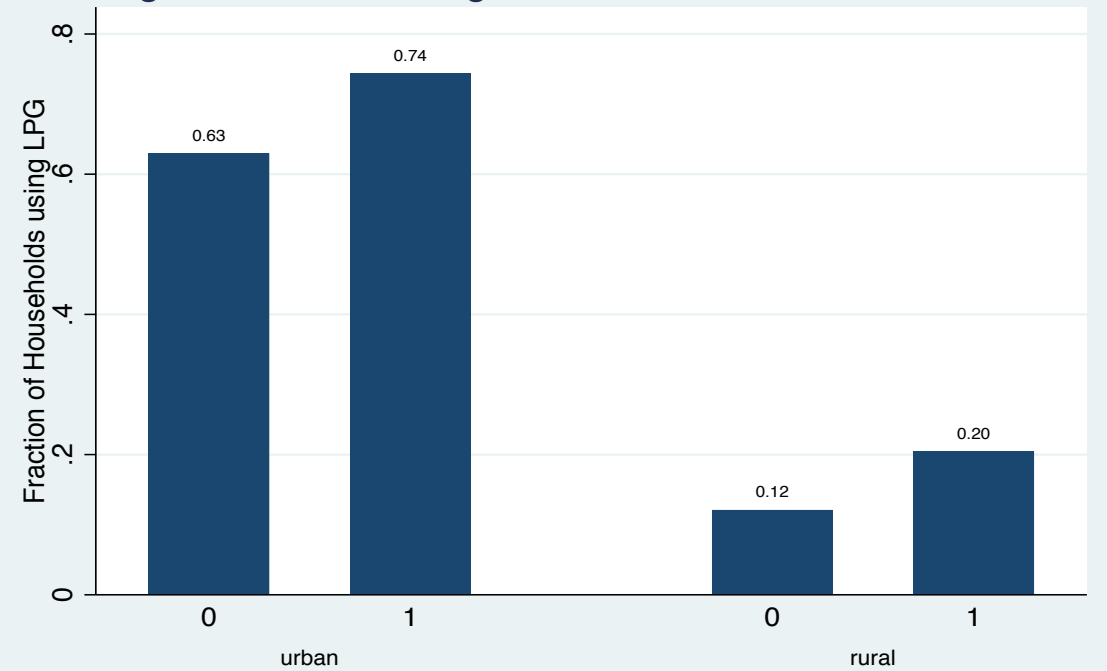


Figure 11. LPG Usage in Rural and Urban Households



POLICY EFFECTIVENESS

Figure 16. LPG Usage Based on Environment and Sex

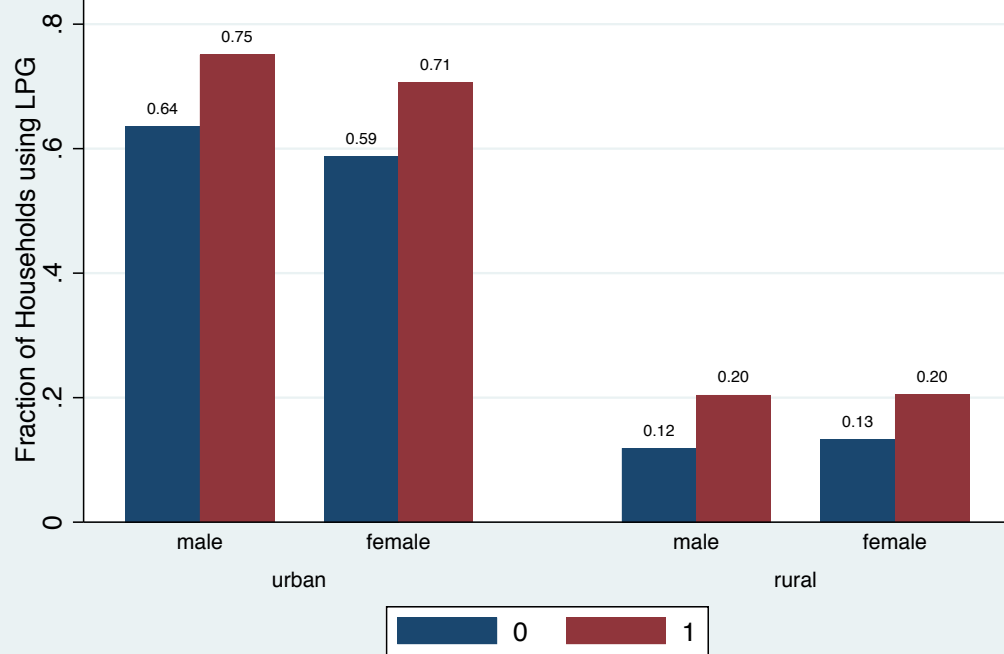
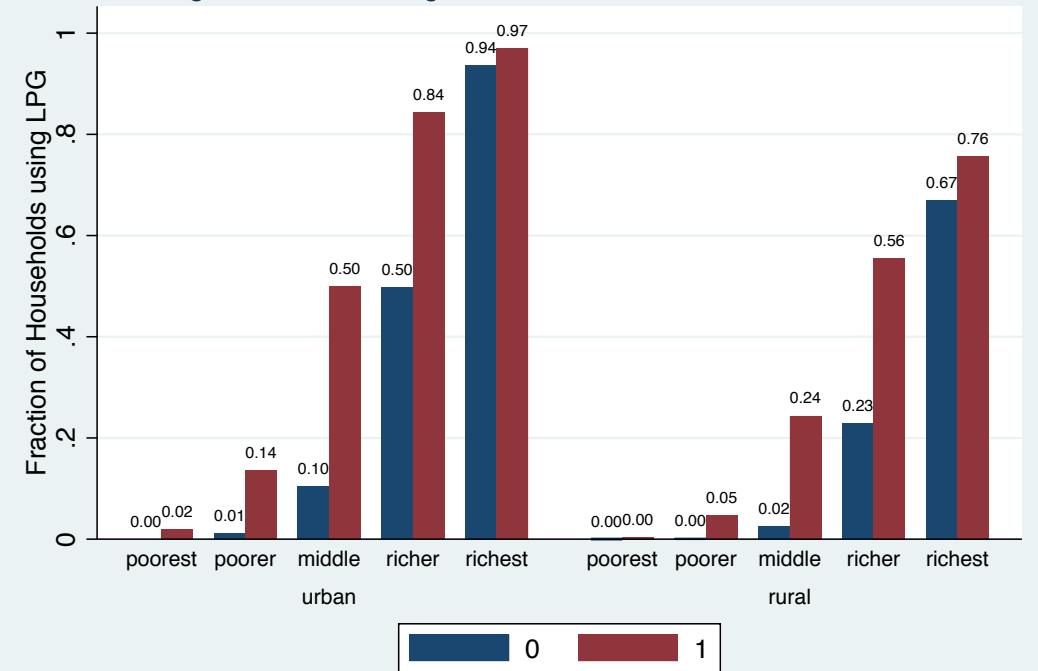


Figure 15. LPG Usage based on on Environment and Wealth



STATE IMPACT (LPG USAGE PERCENTAGE)

India	Before Policy	After Policy	difference
tamil nadu	35.34	65.12	29.78
kerala	26.48	54.17	27.69
delhi	71.32	96.31	24.99
punjab	38.56	62.55	23.99
goa	58.33	79.16	20.82
haryana	27.37	47.80	20.43
karnataka	27.00	43.91	16.92
andhra pradesh	46.02	60.81	14.80
tripura	20.53	30.33	9.80
rajasthan	23.98	32.28	8.30
arunachal pradesh	32.11	40.36	8.25
uttarakhand	36.76	44.18	7.43
gujarat	38.07	43.33	5.26
uttar pradesh	27.51	31.97	4.46

India	Before Policy	After Policy	difference
odisha	12.84	17.15	4.30
jammu and kashmir	30.10	32.96	2.86
jharkhand	13.73	16.54	2.81
sikkim	52.52	54.05	1.53
bihar	19.73	16.86	-2.87
manipur	39.06	34.82	-4.24
himachal pradesh	42.20	37.16	-5.04
west bengal	28.92	23.24	-5.68
mizoram	62.99	57.26	-5.73
assam	29.31	22.85	-6.45
nagaland	32.85	26.17	-6.68
maharashtra	55.31	47.43	-7.88
meghalaya	24.68	14.17	-10.52
madhya pradesh	39.40	27.49	-11.90

STATE IMPACT - RURAL COMMUNITIES (LPG USAGE PERCENTAGE)

India	Before Policy	After Policy	Difference	India	Before Policy	After Policy	Difference
tamil nadu	14.24	53.63	39.39	jammu and kashmir	15.49	25.85	10.37
andhra pradesh	15.51	47.73	32.22	uttarakhand	18.17	28.01	9.85
delhi	55.61	85.71	30.11	west bengal	2.38	10.07	7.69
punjab	17.35	47.24	29.89	madhya pradesh	2.55	9.11	6.56
kerala	20.17	48.74	28.57	odisha	2.63	9.13	6.50
goa	41.30	68.18	26.88	gujarat	16.60	23.09	6.49
karnataka	7.90	28.38	20.48	tripura	10.29	16.01	5.73
haryana	10.17	27.68	17.51	jharkhand	0.89	5.64	4.76
himachal pradesh	19.30	33.31	14.01	nagaland	8.91	11.02	2.10
uttar pradesh	3.68	16.22	12.54	manipur	22.87	23.93	1.06
rajasthan	2.85	14.91	12.07	bihar	11.19	10.42	-0.77
arunachal pradesh	16.68	28.08	11.40	assam	16.68	14.64	-2.04
sikkim	29.70	41.08	11.38	mizoram	35.25	31.54	-3.71
maharashtra	16.06	27.31	11.25	meghalaya	8.91	4.98	-3.92

POLICY SHORTCOMINGS

- Literature fails to highlight the lasting effects of the policy
- Barriers faced when adopting LPG as a new cooking fuel:
 - High costs for refill tanks and stove maintenance
 - Lack of distribution structure in rural India
 - Hence, unable to physically retrieve refill tanks even if people can afford them

FUTURE DIRECTIONS

Apply a difference in difference econometric model to qualitatively measure the impact the policies had on rural population

Develop regression models for mother's and children's health outcomes with variables controlling for environment, gender roles, income, education, accessibility

	(1)	(2)	(3)	(4)	(5)
VARIABLES	lpg	lpg	lpg	lpg	lpg
urban_rural	-0.525*** (0.0184)	-0.197*** (0.0173)	-0.196*** (0.0174)	-0.195*** (0.0171)	-0.206*** (0.0178)
2.wealth_index - Poorer		0.0344*** (0.00636)	0.0350*** (0.00640)	0.0265*** (0.00708)	0.0288*** (0.00784)
3.wealth_index - middle		0.228*** (0.0258)	0.228*** (0.0259)	0.214*** (0.0268)	0.220*** (0.0270)
4.wealth_index - richer		0.547*** (0.0322)	0.548*** (0.0324)	0.526*** (0.0337)	0.537*** (0.0343)
5.wealth_index - richest		0.765*** (0.0186)	0.766*** (0.0186)	0.736*** (0.0206)	0.752*** (0.0243)
2.hh_head_sex - female			0.0203*** (0.00481)	0.0359*** (0.00606)	0.0344*** (0.00607)
1.hh_head_ed - primary				0.00919 (0.00679)	0.00591 (0.00690)
2.hh_head_ed - secondary				0.0555*** (0.00850)	0.0476*** (0.00830)
wave4					0.150*** (0.0192)
Constant	1.244*** (0.0280)	0.387*** (0.0339)	0.383*** (0.0340)	0.364*** (0.0322)	0.251*** (0.0420)
Observations	699,258	699,258	699,258	696,320	696,320
R-squared	0.258	0.536	0.536	0.539	0.550

LESSONS LEARNED

- Analyzing the impact health policy has on populations
- Regression analysis of a multifaceted problem
- Exploration of a new field to broaden my research experiences

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Q & A