Does Exposure to Air Pollution Affect Newborn and Child Health Outcome? Evidence in India.

ECON 0466 Environment Development

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Significance of this study

- Air pollution is one of the most serious environmental problems in the world.
  - Air pollution was responsible for **1.1 million** deaths in India in 2015 (HEI 2018).

- Air pollution is strongly associated with **reduced birth weight** and **decline in lung function** (Padhi et al. 2008).
  - Estimates indicate that **7.6 %** of all deaths in children aged under 5 years in India can be attributed to household air pollution (Neogi et al. 2015).

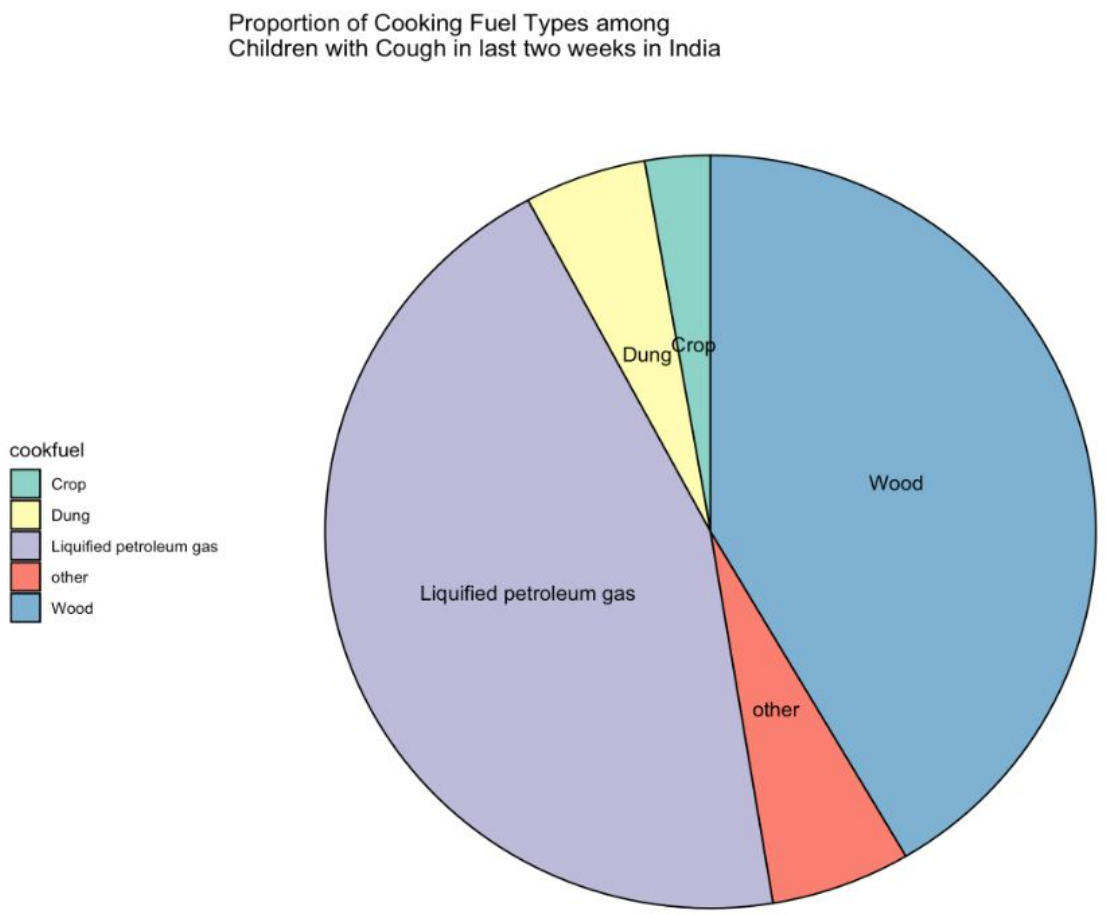
Literature Review

- **Exposure to air pollution affect infant and children health by**:
  - having lower birth weight -> (Guttikunda et al. 2014)
  - increasing neonatal mortality (Korten et al. 2017)
  - exposing to solid cooking fuels smoke -> impairing lung function (Padhi et al. 2008)
- **Maternal smoking**
  - negative child height-for-age in Cambodia and Nepal (Kyu et al. 2009).
- **Maternal education level**
  - greater access to medical cares, improved nutrition, and better immunization coverage (Vikram and Vanneman, 2019).

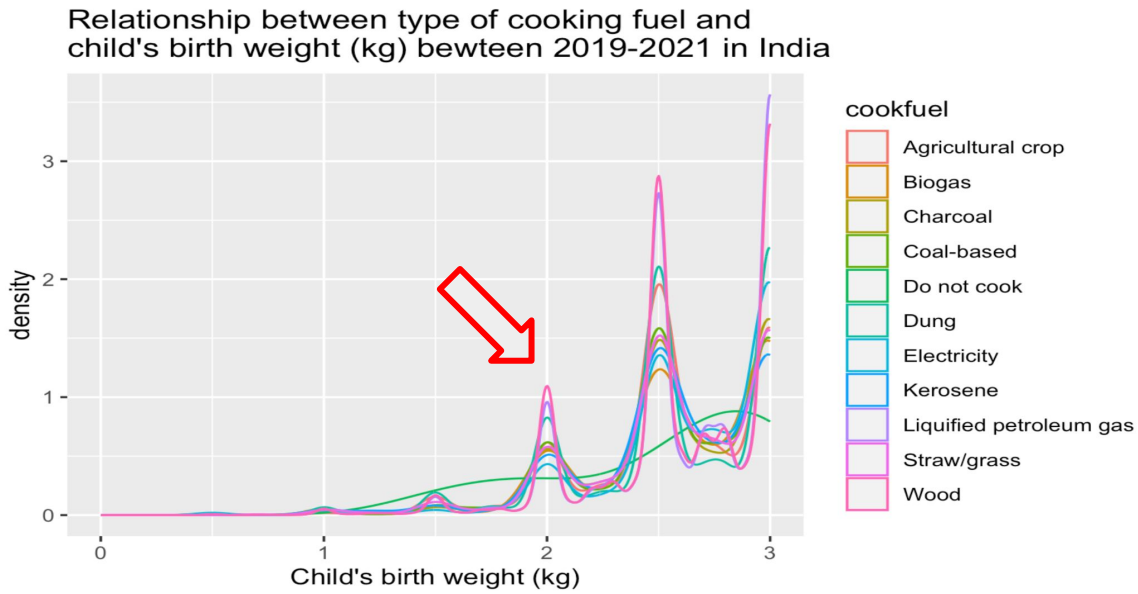
Data Summary

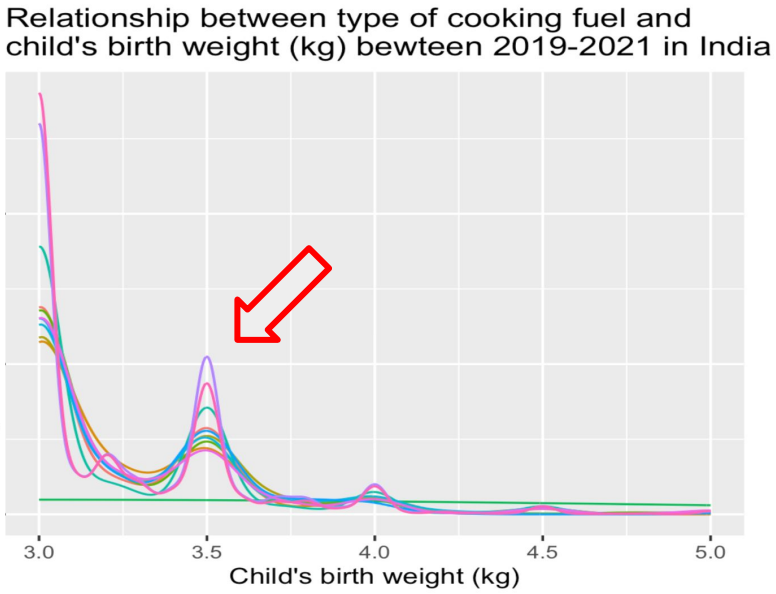
- **Dataset**: Demographic Health Survey (DHS)
- **Unit**: children under the age of five (232,920 observations)
- **Health outcome variables**:
  - 1) birth weight
  - 2) height for age z-score
  - 3) incidence of cough accompanied by shortness of breath
- **Independent variable**: type of cooking fuel

Data Summary Cont.



Relationship between type of cooking fuel and birth weight





Data Summary Cont.

- **Control variables:** household-level demographic and socioeconomic data

Table of Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
cough					
no	161,463	0.998	0.040	0	1
yes	161,463	0.002	0.040	0	1
birth weight	166,041	2.822	0.554	0.5	5
height for age	166,041	-1.715	0.811	-3	3.96
cook fuel					
electricity	166,041	0.011	0.106	0	1
lpg	166,041	0.467	0.499	0	1
biogas	166,041	0.003	0.059	0	1
kerosene	166,041	0.004	0.063	0	1
coal	166,041	0.008	0.089	0	1
charcoal	166,041	0.009	0.092	0	1
wood	166,041	0.422	0.494	0	1
straw	166,041	0.010	0.099	0	1
crop	166,041	0.018	0.134	0	1
animal dung	166,041	0.046	0.209	0	1
no cooking	166,041	0.000	0.009	0	1
other	166,041	0.001	0.030	0	1
education					
no education	166,041	0.188	0.391	0	1
primary	166,041	0.120	0.325	0	1
secondary	166,041	0.540	0.498	0	1
higher	166,041	0.152	0.359	0	1
wealth index					
poorest	166,041	0.229	0.420	0	1
poorer	166,041	0.226	0.418	0	1
middle	166,041	0.205	0.404	0	1
richer	166,041	0.188	0.390	0	1
richest	166,041	0.153	0.360	0	1
smoke status					
no	166,041	0.998	0.040	0	1
yes	166,041	0.002	0.040	0	1
urban					
urban	166,041	0.217	0.412	0	1
rural	166,041	0.783	0.412	0	1
insurance					
no	166,041	0.712	0.453	0	1
yes	166,041	0.288	0.453	0	1
state					
jammu	166,041	0.029	0.168	0	1
himachal	166,041	0.013	0.113	0	1
chandigarh	166,041	0.001	0.029	0	1

Notes: The unit of observation for three health outcomes variables are individual children below age 5, while the rest are household level demographic and socio-economic status. The data describes the entire country of India. The data is retrieved from Demographic Health Survey (2019 - 2021).

Methodology

- **Multivariate OLS Regression**

$$Y_{health} = \beta 0 + \beta 1_{cookfuel} + \varepsilon \quad (1)$$

  - X is denoted as a vector of demographic and control variables
  - G is denoted as a fixed effect for geographic locations.

$$Y_{health} = \beta 0 + \beta 1_{cookfuel} + \beta 2_{X} + \beta 3_{G} + \varepsilon \quad (2)$$

Result

TABLE 1 THE IMPACT OF AIR POLLUTION ON CHILD HEALTH OUTCOME

Dependent variable	Incidence of Cough		Birth Weight		Height for Age z-score	
	(1)	(2)	(3)	(4)	(5)	(6)
Cook fuel						
LPG	0.020	-0.010	-0.0372***	-0.017	-0.228***	-0.0444**
	(-0.0151)	(-0.0158)	(-0.0133)	(-0.0134)	(-0.0227)	(-0.021)
Coal	0.108***	0.0689***	-0.144***	-0.0563***	-0.504***	-0.0847***
	(-0.0259)	(-0.0265)	(-0.0204)	(-0.0206)	(-0.0301)	(-0.0287)
Charcoal	0.107***	0.0465*	-0.0659***	-0.010	-0.467***	-0.0724**
	(-0.0253)	(-0.0255)	(-0.0201)	(-0.0199)	(-0.0299)	(-0.0281)
Wood	0.013	-0.023	-0.102***	-0.021	-0.378***	-0.021
	(-0.0151)	(-0.0159)	(-0.0133)	(-0.0135)	(-0.0227)	(-0.0211)
Straw	0.151***	0.0655**	-0.134***	-0.0510**	-0.492***	0.009
	(-0.0248)	(-0.0257)	(-0.0194)	(-0.0198)	(-0.0295)	(-0.0281)
Crop	0.146***	0.0737***	-0.144***	-0.0507***	-0.361***	-0.017
	(-0.0208)	(-0.0216)	(-0.0167)	(-0.017)	(-0.0268)	(-0.0254)
Animal dung	0.0469***	0.001	-0.116***	-0.0327**	-0.463***	-0.029
	(-0.017)	(-0.018)	(-0.0148)	(-0.0152)	(-0.0241)	(-0.0228)
Smoke status	No	Yes	No	Yes	No	Yes
Insurance	No	Yes	No	Yes	No	Yes
Education	No	Yes	No	Yes	No	Yes
Urban	No	Yes	No	Yes	No	Yes
Wealth index	No	Yes	No	Yes	No	Yes
State fixed effects	No	Yes	No	Yes	No	Yes
Constant	0.236***	0.138***	2.894***	2.782***	-1.405***	-1.327***
	(-0.0149)	(-0.0166)	(-0.0131)	(-0.0149)	(-0.0225)	(-0.0235)
Observations	161,463	161,463	166,041	166,041	166,041	166,041
R-squared	0.001	0.015	0.004	0.043	0.013	0.097

Notes: Table presents estimates of equation (1) where the dependent variable is reported health indicator for children under the age of 5. Columns 1-2 report results for cough, columns 3-4 report results for birth weight, and columns 5-6 for height for age z-score. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

- Note: the base level is electricity, so the negative sign of estimates in all columns indicates that every cook fuel yield a higher likelihood of adverse child health outcomes.

Limitations

- DHS survey is based on mothers self-perception
  - recall error
- Incidence of cough is a limited indicator for children respiratory disease.
  - Variables such as frequency of cough, the likelihood of taking asthma medication, blood test, etc.
- Fail to include outdoor air pollution in regression
  - India Air Quality Data Set
  - Spatial analysis or time series analysis

Conclusions

- Household air pollution significantly increases the incidence of cough, while reduces birth weight and height for age z-score in children under age of 5.

- LPG is a cleaner fuel than wood and other biomass in India (Gould & Urpelainen 2018), but significantly decrease birth weight and height for age z-score.

- On average, children in **urban**, **wealthier households** with **higher maternal education** have higher birth weight and height for age z-score, while lower incidence of cough, holding household air pollution constant.

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