The child health impacts of coal: Evidence from India's coal expansion

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Online Appendix

I Additional Background

I.A Pollution from India's coal plants

The combustion of coal releases a host of pollutants including sulfur dioxide, nitrous oxide, particulate matter, and heavy metals. Relative to American coal, Indian coal has particularly high ash content (Guttikunda and Jawahar, 2014). The high ash content of Indian coal is part of the reason why coal plants in India require more energy to produce a kilowatt-hour of electricity compared to plants in the US (Chan, Cropper and Malik, 2014; Guttikunda and Jawahar, 2014; Malik et al., 2015).

The Indian government has instituted several pollution control measures for coal plants (Guttikunda and Jawahar, 2014). However, the absence of publicly available continuous emissions monitoring data makes enforcement of the few regulations that exist difficult. Electrostatic precipitators (ESPs), which remove particles from the smoke coming out of the stack, are installed in all coal plants in India. However, ESPs are more efficient at removing large particles, so much of the particulate matter that remains is less than 10 microns in diameter, which is more harmful for human health than larger particles. India issued its first regulations governing emissions of nitrous oxide and sulfur dioxide from coal plants in December 2015, near the end of the study period. To date, few coal plants have installed technologies for the removal of these pollutants (Montrone, Ohlendorf and Chandra, 2021).

I.B Coal plants and child health

Recognizing the uniquely harmful impacts of emissions from coal plants on child health, a growing epidemiological literature summarized by Amster and Lew Levy (2019) examines the effects of coal plant exposure on child morbidity and mortality. Although many of these studies have relatively small sample sizes and are constrained in their ability to address potential confounders, they find suggestive evidence that exposure to coal-fired power plant emissions adversely affects neurodevelopment in children, birth weight, height, and respiratory morbidity.

In India in particular, Gupta and Spears (2017) use panel data to show that increased exposure to coal plants is associated with worse respiratory health. Beyond respiratory morbidity, a recent study by Cropper et al. (2021) projects mortality from current and planned coal plants in India. In the absence of mortality data, they apply concentration-response functions from the 2019 Global Burden of Disease to models of coal plant emissions, and predict that about 112,000 deaths are attributable annually to current and planned coal plants in India. Cropper et al. (2017) and Cropper et al. (2019) use similar model-based methods to study the costs and benefits of installing desulfurization units to reduce sulfur dioxide emissions from coal plants. Barrows, Garg and Jha (2019) find effects of India's coal plants on infant mortality using district-level annual data from India's civil registration system. In this paper, I estimate the effect of exposure to coal plants in India on child height using nationally-representative survey data. To my knowledge, this is the first paper to study effects on child height in a framework that addresses concerns related to endogeneity and confoundedness.

Child linear growth is a complex process that begins *in utero*. Children are at the highest risk of growth impairment up to the age of 24 months. The factors that contribute to impaired growth include poor maternal nutrition during pregnancy, inadequate nutrient intake after birth, and recurrent infection. Why children in India are even shorter than children in much poorer sub-Saharan Africa has long been a puzzle in development economics. Researchers have proposed persistent open defecation (Spears, 2018), poor maternal nutrition (Coffey, 2015; Coffey and Spears, 2019), and son-preference (Jayachandran and Pande, 2017) as important Indian characteristics that can explain at least part of the observed difference in height between the two regions.

More recently, researchers have proposed air pollution as an important contributor to stunting. The mechanisms linking air pollution to growth faltering are not precisely known. Based on the existing medical and epidemiological literatures, Sinharoy, Clasen and Martorell (2020) discuss how prenatal and postnatal exposure to air pollution may contribute to stunting. Air pollution exposure introduces reactive oxygen species, which, if not balanced by antioxidants, can damage fatty tissue, DNA, and proteins in the body through oxidative stress. When this occurs during pregnancy, it may affect the functioning of the placenta and lead to poor fetal growth. Postnatally, exposure to air pollution might impair growth through repeated respiratory illness accompanied by fever. It is likely that this occurs because of reduced dietary intake during illness combined with enhanced metabolic requirements of the immune system to fight off infection. Repeated postnatal exposure to air pollution may also bring about chronic inflammation which can interfere with growth processes. Both prenatally and postnatally, air pollution might contribute to vitamin D deficiency, which plays an important role in bone growth. Notably, the mechanisms outlined here suggest that vitamin and nutrient supplementation might mediate the impacts of air pollution exposure on linear growth. Research in epidemiology suggests that this may be the case, but the evidence is still limited (Romieu et al., 2008). This area of research requires further inquiry. Unfortunately, the DHS does not contain information on vitamin D supplementation.

I.C Other government programs related to child health

During the period of study, the Government of India launched two national-level development programs that could plausibly have had impacts on child height: the Swacch Bharat Mission (SBM), a toilet-building campaign, in October 2014, and the Ujjwala Yojana, a program that subsidized liquefied petroleum gas (LPG) for rural households, in May 2016. Prior research has shown that the SBM did little to accelerate the reduction in open defecation during the study period (Coffey and Spears, 2018; Gupta et al., 2020*a*). Ujjwala was launched immediately prior to the end of the study period, and therefore would have had little impact on child health during the study period. Moreover, research on the impact of Ujjwala has also found that program beneficiaries continued to use solid fuels very frequently (Gupta et al., 2020*b*). These programs are therefore unlikely to confound the impacts estimated in this paper on the expansion in coal plant capacity because they did little to change the harmful environmental factors that impact child height.

Figure A1: Effects may be slightly steeper at higher capacity levels

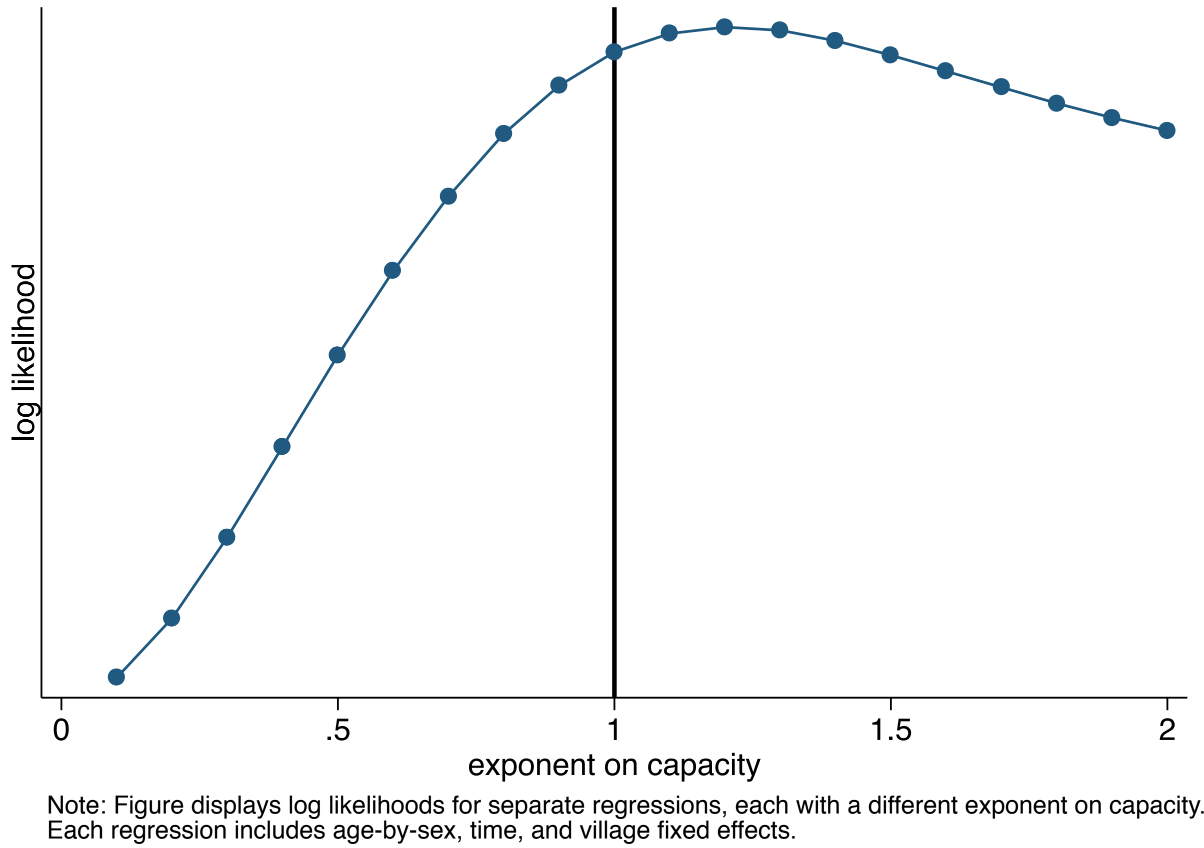
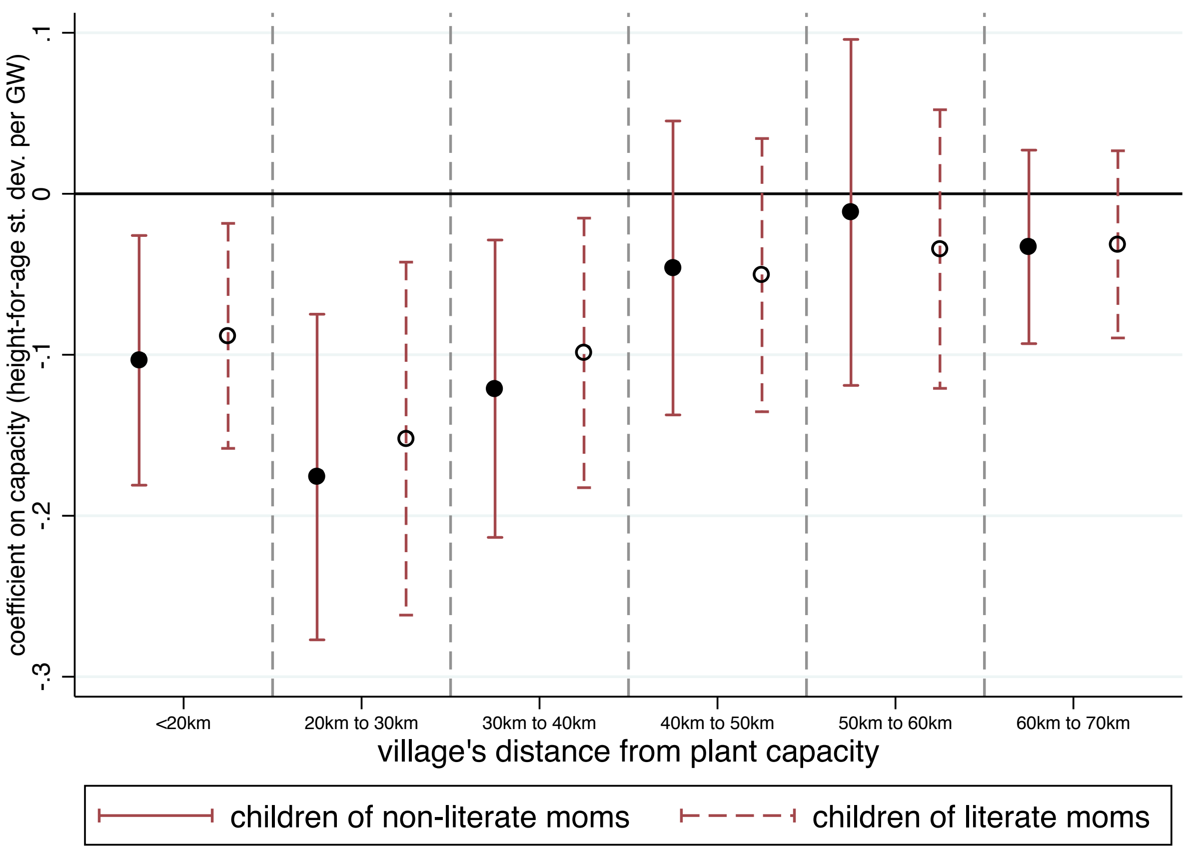


Figure displays log likelihoods for separate regressions, each with a different exponent on capacity in the month of birth, increasing in steps of 0.1 from 0.1 to 2.0. Regressions replicate the specification shown in Table 2, column 1, except that the linear form of capacity is replaced by a power transformation. Exposed children are those in villages within 0 and 50 km of any installed coal plant. Unexposed children are those in villages farther than 50 km of all installed coal plants. Each regression has a sample size of 223,166 children, and includes age-by-sex, month-by-year of birth (cohort), and village fixed effects. Standard errors clustered by district. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Figure A2: Dataset is not powered to detect differential effects by SES within distance bins



The figure displays coefficients from a single regression of height-for-age z-score on capacity in the month of birth within each of the described distance bins, interacted with mother's literacy. The regression is implemented by replacing *capacity* in Equation 4 with capacity in different distance bins, from zero to 20 km, 20 to 30 km, 30 to 40 km, etc, until a distance of 70 km. Distance bins are not mutually exclusive categories: some children are born in villages that have exposure to coal plants within multiple distance bins. The sample consists of 221,575 children. Regression includes age-by-sex, month-by-year of birth (cohort), and village fixed effects. Standard errors clustered by district. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A1: Effect of coal capacity on height attenuates as distance increases

Dependent variable:	**Height-for-age z-score**
Capacity (GW) X distance (km)	0.00169*
	(0.000680)
Capacity (GW)	-0.137**
	(0.0406)
Distance (km)	0.00111
	(0.000780)
N (children under 60 months)	94,022
Sex-by-age in months FE	yes
Month-by-year (cohort) FE	yes
Village FE	yes

The regression results reported in this table test whether the effect of coal plant capacity in the month of birth differs by distance from the coal plant. For villages that are exposed to only one coal plant, *distance* is the distance in kilometers from the coal plant. For villages that are exposed to multiple coal plants, *distance* is a weighted average of all coal plants to which the village is exposed. Weights are the fraction of total capacity that the coal plant contributes for that village in the month of birth. *capacity* is the total coal capacity of plants within 70 km of the village. The sample consists of children born in villages within 70 kilometers of any coal plant installed prior to December 2016. Both *capacity* and *distance* are continuous variables in this regression. Standard errors clustered by district. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A2: Coal plant capacity is associated with higher ambient air pollution within villages over time

Dependent variable:	**$PM_{2.5}$ (μg/m^3)**			
	(1)	(2)	(3)	(4)
Capacity (GW)	3.450**	1.250**	0.686**	0.661**
	(0.872)	(0.312)	(0.227)	(0.224)
N (village-month-years)	2,317,074	2,317,074	2,317,074	2,317,074
Village FE		yes	yes	yes
Month-by-year FE			yes	yes
Weather characteristics				yes

The table shows coefficients from regressions of $PM_{2.5}$ (μg/m^3) on capacity. Observations are village-month-years. See Section V.B for more detail on the regression equation. Analysis covers the study period, from February 2010 to November 2016. Column 1 reports the estimate from a univariate regression of air pollution on coal plant capacity. Column 2 includes village fixed effects and column 3 includes village and month-by-year fixed effects. Column 4 adds weather characteristics, including the average temperature and total precipitation in the village in the month-year. Standard errors clustered by district. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016, the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector, Princeton Meteorological Forcing Dataset, and Dey and Ganguly (2021) data on $PM_{2.5}$.

Table A3: Associations of height-for-age with other birth and household characteristics

Dependent variable:	**Height-for-age z-score**		
	Coefficient	**S.E.**	**N**
	(1)	(2)	(3)
Mom's age at birth	0.00336**	(0.00114)	222,069
Birth order	-0.0593**	(0.00373)	222,069
Multiple birth	-0.236**	(0.0355)	222,069
Institutional delivery	0.119**	(0.0132)	222,069
C-section	0.151**	(0.0167)	222,069
Breastfeeding w/in 1 hr of birth	-0.0242	(0.0148)	157,860
Iron supplements	0.0783**	(0.0165)	164,775
Drug for intestinal parasites	0.0599**	(0.0203)	163,644
Number of antenatal visits	0.0167**	(0.00243)	163,638
Mom is literate	0.285**	(0.0133)	220,486
Mom's height	0.0474**	(0.00119)	222,069
Wealth quintile			222,069
1st quintile	omitted	omitted	
2nd quintile	0.183**	(0.0157)	
3rd quintile	0.406**	(0.0208)	
4th quintile	0.585**	(0.0245)	
5th quintile	0.851**	(0.0301)	

The table displays coefficients from separate regressions of height-for-age z-score on various birth and household characteristics. S.E. represents standard errors. Sample sizes differ slightly due to data availability of characteristics. Regressions include sex-by-age-in-months, month-by-year of birth (cohort), and village fixed effects. Standard errors clustered by district. Regressions use survey sample weights. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016.

Table A4: Light output at night is not an omitted variable in analysis of child height and coal capacity

Dependent variable:	**Height-for-age z-score**		
Sample:	**Full**	**Night lights**	
	(1)	(2)	(3))
Capacity (GW)	-0.103**	-0.0718+	-0.0717+
	(0.0298)	(0.0395)	(0.0395)
Median monthly night lights			-0.000464
			(0.00103)
N (children under 60 months)	222,069	105,958	105,958
Sex-by-age in months FE	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes
Village FE	yes	yes	yes

The table shows fixed effects regressions described by a simplified version of Equation 1. Column 1 repeats the main result from column 1 of Table 2. Column 2 shows estimates from the same regression as column 1, but limits the sample to children born from February 2010 through December 2013, the period for which night light data is available. Column 3 adds median monthly night lights as a control variable. Because most DHS village locations are randomly displaced by up to 5 km, night light values for DHS villages are estimated as the mean of night lights for 2001 Census villages located within 5 km of the DHS village. The dependent variable in all models is height-for-age z-score. Exposed children are those in villages within 0 and 50 km of any installed coal plant. Unexposed children are those in villages farther than 50 km of all installed coal plants. Standard errors clustered by district. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016, the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector, and The World Bank and Min (2017) data on light output at night for India's 2001 Census villages.

Table A5: The main effect holds with mother and household fixed effects

Dependent variable:	**Height-for-age z-score**						
Sample:	**Main**	**Mother FE**		**Not mother FE**	**Household FE**		**Not household FE**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capacity (GW)	-0.100**	-0.124**	-0.112**	-0.100**	-0.122**	-0.118**	-0.0865**
	(0.0305)	(0.0400)	(0.0364)	(0.0360)	(0.0429)	(0.0411)	(0.0304)
N (children under 60 months)	222,069	97,444	97,444	123,512	110,221	110,221	110,346
Sex-by-age in months FE	yes	yes	yes	yes	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes	yes	yes	yes	yes
Village FE	yes		yes	yes		yes	yes
Birth order & sibsize FE	yes	yes	yes	yes	yes	yes	yes
Mother FE		yes					
Household FE					yes		

This table reports regressions similar to that presented in Table 2, column 1, except that alternative fixed effects are used. Column 1 reports the results using the main sample, which is the same sample as is used in Table 2, column 1. Columns 2 and 3 only include children in the mother fixed effects sample, that is children aged <60 months who have other siblings in the sample aged <60 months. Column 2 includes mother fixed effects, and column 3 leaves mother fixed effects out, but uses the same sample of children. Column 4 includes children who are not in the mother fixed effects sample: children aged <60 months who do not have other siblings in the sample aged <60 months. Columns 5 and 6 only include children in the household fixed effects sample: children aged <60 months who have other household members in the sample aged <60 months. Column 5 includes household fixed effects, and column 6 leaves household fixed effects out, but uses the same sample of children. Column 7 includes children who are not in the household fixed effects sample: children aged <60 months who do not have other household members in the sample aged <60 months. Exposed children are those in villages within 50 km of any installed coal plant. Unexposed children are those in villages farther than 50 km from all installed coal plants. Standard errors clustered by district. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A6: The main effect is not driven by particular subsamples

	Dependent variable: Height-for-age z-score									
Sample:	**Main sample**	**Born in survey village**	**Mom in survey village $\geq$ 6 yrs**	**Expansions in existing plants only**	**New plants only**	**Exposed villages only**	**Village Δ capacity $\leq$**		**Villages exposed to plants $\leq$**	
							99th %ile	**97th %ile**	**99th %ile**	**97th %ile**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capacity (GW)	-0.103**	-0.106**	-0.0944**	-0.123**	-0.104**	-0.0884**	-0.103**	-0.0991**	-0.0727**	-0.0858**
	(0.0298)	(0.0309)	(0.0335)	(0.0427)	(0.0304)	(0.0325)	(0.0253)	(0.0360)	(0.0261)	(0.0286)
N (children under 60 months)	222,069	205,067	128,926	176,303	192,790	63,145	220,102	216,345	221,617	221,106
Sex-by-age in months FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Village FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

This table reports regressions similar to that presented in Table 2, column 1, except that different parts of the sample are dropped from the regression. Column 1 repeats the results from Table 2, column 1 for comparison. Column 2 only includes children born in the same village in which the household was interviewed by DHS surveyors. Column 3 only includes children born to mothers who have lived in the same location, where the household was interviewed, for more than five years. Column 4 only includes villages that experienced coal plant expansions, rather than new sites, as well as unexposed villages. Column 5 only includes villages within 50 kilometers of any coal plant installed after February 2010, as well as unexposed villages. Column 6 only includes villages within 50 kilometers of any coal plant operational between February 2010 and November 2016. Columns 7 and 8 drop villages with increases in capacity above varying thresholds. Columns 9 and 10 drop villages exposed to coal plants that are above certain capacity thresholds at the end of the study period, in November 2016. Column 9 drops villages exposed to the largest coal plant. Column 10 drops villages exposed to the five largest coal plants. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A7: Alternative unexposed group: villages within 50 and 100 km of coal plant

Dependent variable:	**Height-for-age z-score**					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Coal capacity (median plant capacity is 1 GW)						
Capacity (GW)	-0.101**	-0.0599*	-0.101**	-0.101**	-0.101**	-0.0573*
	(0.0228)	(0.0274)	(0.0230)	(0.0232)	(0.0231)	(0.0271)
Panel B: Coal units (median plant has 3 units)						
Units	-0.0259*	-0.0152	-0.0256*	-0.0261*	-0.0261*	-0.0144
	(0.0118)	(0.0130)	(0.0118)	(0.0118)	(0.0118)	(0.0128)
N (children under 60 months)	131,500	131,500	131,500	131,500	131,500	131,500
Sex-by-age in months FE	yes	yes	yes	yes	yes	yes
Month-by-year (cohort) FE	yes		yes	yes	yes	
Village FE	yes	yes	yes	yes	yes	yes
Plant-by-year FE		yes				yes
Birth characteristics			yes	yes	yes	yes
Household characteristics				yes	yes	yes
Weather characteristics					yes	yes

The table shows fixed effects regressions similar to those described by Equation 1, and is comparable to Table 2, except that the unexposed group consists of children in villages farther than 50 km of all coal plants, and within 50 and 100 kilometers of at least one coal plant installed by December 2016. Exposed children are those in villages within 0 and 50 km of any installed coal plant. Panels A and B show coefficients from two separate regressions: in panel A, the exposure variable is coal plant capacity in the month of birth, and in panel B, the exposure variable is the number of coal plant units in the month of birth. One gigawatt (GW) in coal plant capacity corresponds to the size of the median coal plant in the dataset. The median plant in the data has 3 units. The dependent variable in both panels is height-for-age z-score. Column 1 is analogous to Table 2, column 1. Column 2 replaces cohort fixed effects with plant-by-year fixed effects. Columns 3, 4, and 5 go back to the original cohort fixed effects and progressively add control variables. Column 6 includes all control variables and replaces cohort fixed effects with plant-by-year fixed effects. Birth characteristics include mother's age at birth, birth order, multiple birth, institutional delivery, and c-section delivery. Household characteristics include mother's height, religion, caste, literacy, household open defecation, and use of solid fuels for cooking. Weather characteristics include the average temperature and total precipitation in the village in the month of birth. Standard errors clustered by nearest plant. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016, the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector, and the Princeton Meteorological Forcing Dataset.

Table A8: Summary Statistics: alternative unexposed group

	Exposure (≤50km from coal plant) (1)	**No exposure** ∈(50, 100] (2)	**Difference** (3)
Height-for-age z-score	-1.489	-1.604	0.115**
Capacity (GW)	1.192	0	1.192**
Generation units	5.493	0	5.493**
Child's age (months)	30.30	29.87	0.423**
Female	0.479	0.481	-0.00154
Birth order	2.179	2.290	-0.111**
Multiple birth	0.0130	0.0133	-0.000387
Mom's age at birth (years)	24.25	24.33	-0.0810
Institutional delivery	0.778	0.761	0.0162
C-section delivery	0.176	0.144	0.0319**
Mom's height (cm)	151.4	151.2	0.238*
Mom's literacy	0.671	0.611	0.0605**
Hindu	0.771	0.808	-0.0368*
Scheduled caste	0.241	0.231	0.00999
Scheduled tribe	0.0774	0.106	-0.0285**
Rural	0.643	0.797	-0.154**
Defecates in open	0.419	0.552	-0.134**
Uses solid fuel	0.583	0.706	-0.122**
Breastfeeding within 1 hr of birth	0.672	0.662	0.0103
Iron supplements in pregnancy	0.786	0.750	0.0368**
Antihelmintics in pregnancy	0.174	0.170	0.00406
N of antenatal care visits	4.801	4.112	0.688**
N (children under 60 months)	63,695	68,904	

The table reports child-level summary statistics for children with measured height in the DHS. Means are shown separately for children born in villages within 50 kilometers of any coal plant installed prior to December 2016, and children in villages farther than 50 km of all coal plants, and within 50 and 100 kilometers of at least one coal plant installed by December 2016. This table is analogous to Table 1, except in how the unexposed group is defined. Capacity and units refer to coal plant exposure in the month the child was born. By construction, children born in villages with no exposure have zero capacity and units exposure in the month of birth. Female, multiple birth, institutional delivery, C-section delivery, mom's literacy, Hindu, scheduled caste, scheduled tribe, rural, defecates in open, uses solid fuel, early breastfeeding, iron supplements in pregnancy, and antihelmintics in pregnancy, are binary. Means are calculated using sampling weights. Standard errors clustered by nearest plant. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A9: The main effect holds in DHS data pooled across three rounds (1992-1993, 1998-1999, and 2015-2016)

Dependent variable:	**Height-for-age z-score**	
	(1)	(2)
Capacity (GW)	-0.0320*	-0.0337*
	(0.0159)	(0.0167)
N (children under 60 months)	276,563	276,563
Sex-by-age in months FE	yes	yes
Month-by-year (cohort) FE	yes	yes
District-by-survey round FE	yes	yes
Birth characteristics		yes
Household characteristics		yes

Data are pooled from three DHS rounds: DHS-1 (1992-1993), DHS-2 (1998-1999), and DHS-4 (2015-2016). DHS-1 and DHS-2 do not contain geo-coded data on PSUs. Therefore, the analysis uses district fixed effects instead of village (PSU) fixed effects. DHS-3 is omitted because it does not contain district-level identifiers. Districts are merged across DHS rounds taking into account splits, merges, and changes in borders. The resulting dataset is a geographically consistent panel of regions across survey rounds. Coal plant capacity is the total capacity of coal plants operating in the child's district in the child's month of birth. All results include sex-by-age in months, month-by-year (cohort), and district-by-survey round fixed effects. Column 2 adds birth characteristics, including birth order, multiple birth, and institutional delivery. It also adds household characteristics, including rural residence, religion, caste, open defecation, and ownership of radio, television, refrigerator, bicycle, motorcycle, and car. Standard errors clustered by district. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016, 1998-1999, and 1992-1993; and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A10: Testing linearity: Alternative models fit the data no better than the linear model

Dependent variable:	**Height-for-age z-score**					
	(1)	(2)	(3)	(4)	(5)	(6)
Capacity (GW)	-0.103**		-0.0695*			-0.102+
	(0.0298)		(0.0305)			(0.0562)
Capacity x 1[1st quartile]		0.121				
		(0.170)				
Capacity x 1[2nd quartile]		-0.106				
		(0.0799)				
Capacity x 1[3rd quartile]		-0.0591				
		(0.0503)				
Capacity x 1[4th quartile]		-0.0961**				
		(0.0319)				
Capacity^2			-0.00318			
			(0.00225)			
Ln(capacity)				-0.0255+		
				(0.0131)		
Sinh^{-1}(capacity)					-0.163**	
					(0.0487)	
Above median spline						-0.00139
						(0.0690)
N (children under 60 months)	222,069	222,069	222,069	222,069	222,069	222,069
F-statistic $\beta^{\text{1st q}} = \beta^{\text{2nd q}} = \beta^{\text{3rd q}} = \beta^{\text{4th q}}$		1.613				
p-value		0.185				
Sex-by-age in months FE	yes	yes	yes	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes	yes	yes	yes
Village FE	yes	yes	yes	yes	yes	yes

This table reports regressions similar to that presented in Table 2, column 1, except that the linear capacity term is replaced with different transformations of capacity. Column 1 replicates column 1 of Table 2 for reference. Column 2 allows the coefficient on capacity to be different at different quartiles of capacity, but requires the intercept to remain the same. Column 3 includes capacity as a quadratic. Column 4 tests whether the capacity-height relationship is characterized by diminishing marginal deficits using the natural log transformation. $Capacity = 0.01$ replaces $Capacity = 0$ in this regression because Ln(0) is undefined. Column 5 uses a transformation that is defined at zero, the inverse hyperbolic sine function. Column 6 tests an above-median spline. Standard errors clustered by district. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A11: Heterogeneity by open defecation and solid fuel use

Dependent variable:	**Height-for-age z-score**			
	(1)	(2)	(3)	(4)
Capacity (GW) × household open defecation	0.00797			
	(0.0109)			
Capacity (GW) × > median PSU open defecation		0.0143		
		(0.0416)		
Capacity (GW) × household solid fuel use			0.0198	
			(0.0144)	
Capacity (GW) × > median PSU solid fuel use				-0.0351
				(0.0476)
Capacity (GW)	-0.109**	-0.111**	-0.118**	-0.0861**
	(0.0277)	(0.0314)	(0.0317)	(0.0266)
N (children under 60 months)	210,361	222,069	210,554	222,069
Sex-by-age-in-months FE	yes	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes	yes
Village FE	yes	yes	yes	yes

Columns 1 and 2 explore heterogeneity by open defecation, and Columns 3 and 4 explore heterogeneity by solid fuel use. Column 1 interacts coal plant exposure with an indicator for household open defecation. Column 2 interacts coal plant exposure with an indicator for above-median PSU (village) open defecation, estimated by averaging over households defecating in the open in the village. Column 3 interacts coal plant exposure with an indicator for household solid fuel use. Column 4 interacts coal plant exposure with an indicator for above-median PSU (village) solid fuel use, calculated in the same way as the PSU open defecation variable. Standard errors clustered by district. ** p<0.01, * p<0.05, + p<0.10. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A12: Coal plant capacity and other anthropometric measures

Dependent variable:	**Height-for-age z-score**	**Stunted**	**Weight-for-age z-score**	**Weight-for-height z-score**	**Birth weight (kg)**
	(1)	(2)	(3)	(4)	(5)
Capacity (GW)	-0.103**	0.0261**	-0.0675**	0.000155	0.00813
	(0.0298)	(0.00763)	(0.0114)	(0.0222)	(0.00633)
N (children under 60 months)	222,069	222,069	222,069	222,069	167,340
Sex-by-age in months FE	yes	yes	yes	yes	yes
Month-by-year (cohort) FE	yes	yes	yes	yes	yes
Village FE	yes	yes	yes	yes	yes
Mean	-1.486	0.384	-1.528	-0.966	2.827

This table reports regressions similar to that presented in Table 2, column 1, except that alternative dependent variables are used. Column 1 reports the same results as in Table 2, column 1. Column 2 replaces the dependent variable with an indicator for whether the child is stunted (has a height-for-age z-score < -2.00). The dependent variable in column 3 is weight-for-age z-score, and in column 4 it is weight-for-height z-score. Column 5's dependent variable is birth weight (kg). Exposed children are those in villages within 0 and 50 km of any installed coal plant. Unexposed children are those in villages farther than 50 km of all installed coal plants. Standard errors clustered by district. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A13: The dataset is not powered to detect effects of coal plant capacity on neonatal or infant mortality

Dependent variable:	**Neonatal mortality** (1)	**Infant mortality** (2)
Capacity (GW)	0.0224	0.550
	(0.672)	(0.967)
N (births)	1,307,732	1,259,378
Month-by-year (cohort) FE	yes	yes
Village FE	yes	yes

The table reports regressions of neonatal and infant mortality on coal plant capacity in the month of birth. Sample sizes differ because children who were alive at the time of the survey are only included in the analysis if they had already exited the exposure period, which is the first month of life in column 1, and the first year of life in column 2. Exposed children are those in villages within 0 and 50 km of any installed coal plant. Unexposed children are those in villages farther than 50 km of all installed coal plants. Standard errors clustered by district. ** $p<0.01$, * $p<0.05$, + $p<0.10$. Source: Author calculations using India's Demographic and Health Survey 2015-2016 and the Central Electricity Authority of India's CO_2 Baseline Database for the Indian Power Sector.

Table A14: Assumptions and calculations for population impact

		Estimate (1)	Units (2)	Sources/Notes (3)
A	The mean of populations exposed to plants with capacity of 1GW (capacity of a median-sized coal plant)	3,252,164	people	SHRUG and Census 2011
B	Fraction <1 year	1.9%		Census 2011
C	**Infants exposed to a median-sized coal plant in each year's cohort**	**60,596**		A × B
D	Average annual earnings per capita	27,219	2011 INR	IHDS 2011-2012
E	2011 Exchange rate	47	INR/US$	World Bank Data Catalog
F	Social discount rate	5.0%		Kula (2004)
G	Life expectancy	68		SRS Abridged Life Tables 2011-2015
H	**Present discounted value of earnings per capita**	**11,721**	2011 US$	Author calculation
I	Height-to-earnings relationship (% earnings per tenth of a standard deviation in child height)			
J	Lower bound	0.5%		
K	Upper bound	1.5%		
L	Number of cohorts exposed to coal plant	40	cohorts	Shah (2021)
M	**Cost to earnings among cohorts exposed to a median-sized plant**			
N	**Lower bound**	**142,048,201**	2011 US$	C × H × J × L
O	**Upper bound**	**426,144,603**	2011 US$	C × H × K × L
P	**Capital costs of a median-sized plant**	**932,051,810**	2011 US$	Author calculation based on Shah (2021), and India's inflation and exchange rate from World Bank Data Catalog

Average annual earnings per capita is estimated from IHDS 2011-2012 data using the urban-rural breakdown of the exposed sample, as shown in Table 1. Children born in the future are not discounted. Kula (2004) refers to the paper: "Estimation of a Social Rate of Interest for India," published in Journal of Agricultural Economics. Shah (2021) refers to the report: "Overestimated Financial Viability of India's Coal-fired Power Plants," published by the Institute for Energy Economics and Financial Analysis.