

Rising above the Smoke: How Does Clean Energy Impact Child Development in India?

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 - How gendered are the effects?
- Contribute to the literature on development and environmental economics by employing India's first Nationally representative Time Use Survey, 2019.

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- Human exposure to outdoor and indoor air pollution are crucial risk determinants for morbidity and mortality in developing countries (Li et al., 2023) the burden of which mostly falls on women (Afridi et al., 2023).
- In addition to the important health impacts of switching to cleaner energy, some argue that it could generate important time savings at home (Afridi et al., 2023).

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- As Sen (1999) and Shahin Yaqub (2008) argue, time poverty can greatly affect individual capabilities.
- Certain development projects in low- and middle-income countries can lead to time savings for households, allowing them to allocate this extra time to activities that improve their well-being (Whittington and Cook, 2019).

Table: Variable Descriptions

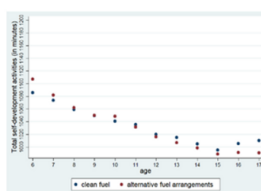
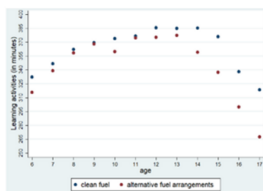
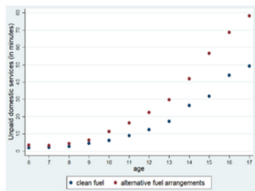
Variables	Description
Unpaid domestic services	Continuous variable: Total time spent on unpaid domestic services like food and meal.
Learning activities	Continuous variable: Total time spent on activities like formal education, homework, additional non-formal courses among others.
Total self-development activities	Continuous variable: Total time spent on socializing and communication, religious practices, culture, leisure, mass media, sports practices, self-care and maintenance.
Clean fuel	Dummy variable: 1=LPG, natural gas, Gobar gas; 0=otherwise.
Clean light	Dummy variable: 1=electricity incl. generated by solar or wind power generators; 0=otherwise.
Female	Dummy variable: 1= female and 0=male

Variables	N	Alternate fuel	N	Clean fuel	MeanDiff
Unpaid domestic services	33,525	29.724	54,170	18.011	11.713***
Learning activities	33,525	340.967	54,170	372.264	-31.296***
Total self-dev activities	33,525	1,028.465	54,170	1,021.6	6.864***

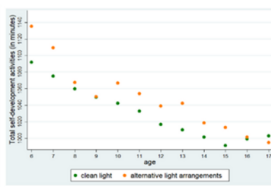
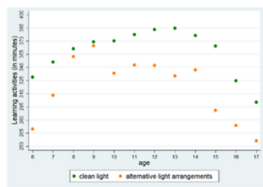
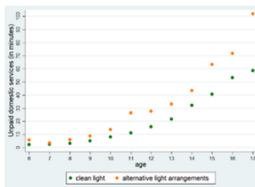
Variables	N	Alternate light	N	Clean light	MeanDiff
Unpaid domestic services	4,271	33.197	83,424	21.94	11.257***
Learning activities	4,271	320.697	83,424	362.327	-41.630***
Total self-dev activities	4,271	1,043.25	83,424	1,023.251	19.999***

Heterogeneity in the time use across age and energy consumption

Panel A: Clean fuel



Panel B: Clean Light



Empirical Strategy and Endogeneity Concerns

$$Y_{ih} = \alpha_h + \beta_{ih}\text{female} + X_{ih}\beta + \varepsilon_{ih} \quad (1)$$

$$Y_{is}^j = \beta_0 + \beta_1\text{clean_fuel}_{is} + \beta_2 X_{is} + \mu_s + u_{is} \quad (2)$$

$$Y_{is}^j = \gamma_0 + \gamma_1\text{clean_light}_{is} + \gamma_3 X_{is} + \eta_s + u_{is} \quad (3)$$

where,

Y_{ih} is the time spent on activities.

α_h represents the household fixed effects.

β_{ih} gives the average difference in time use of the female and male child for different categories.

X_{ih} includes covariates such as age and education, among others.

Endogeneity Concerns:

- Households choose to adopt clean lighting arrangements because of self-selection bias on account of either environmental sustainability or preferences leading to endogeneity issues.
- State wise electricity prices as IV

Model with all controls

VARIABLES	unpaid domestic services	learning time	total self-dev time	unpaid domestic services	learning time	total self-dev time
Clean fuel	-8.662*** (0.634)	9.289*** (2.081)	7.786*** (1.952)	NA	NA	NA
Clean light	NA	NA	NA	-4.834*** (1.470)	15.65*** (4.033)	-4.620 (3.622)
State fixed effects	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Constant	28.20*** (5.299)	185.2*** (17.52)	1,131*** (15.67)	27.65*** (5.534)	176.0*** (17.93)	1,140*** (16.02)
Observations	87,609	87,609	87,609	87,609	87,609	87,609
R-squared	0.177	0.073	0.060	0.174	0.073	0.060

Note: All regressions control for the covariates including sex of the child, current age, age squared/100, household size, rural, usual monthly household consumption expenditure (in INR), upper caste, religion, and state fixed effects. The sample is all the children of the age group 6-17. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The interaction of gender with clean fuel and clean light

VARIABLES	unpaid domestic services	learning time	total self-dev time	unpaid domestic services	learning time	total self-dev time
female	47.48*** (1.035)	-5.335* (2.854)	-30.41*** (2.628)	53.47*** (2.986)	-16.30** (7.729)	-20.70*** (6.851)
Clean fuel	-0.0672 (0.532)	5.450** (2.668)	4.807* (2.566)	NA	NA	NA
Female # clean fuel	-18.89*** (1.204)	8.438** (3.645)	6.546* (3.421)	NA	NA	NA
clean light	NA	NA	NA	3.610*** (0.958)	7.779 (5.404)	-1.713 (5.016)
Female # clean light	NA	NA	NA	-18.06*** (3.038)	16.84** (7.938)	-6.216 (7.065)
State fixed effects	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Constant	23.58*** (5.263)	187.3*** (17.58)	1,133*** (15.73)	19.57*** (5.428)	183.5*** (18.25)	1,138*** (16.37)
Observations	87,609	87,609	87,609	87,609	87,609	87,609
R-squared	0.181	0.073	0.060	0.175	0.073	0.060

Note: All regressions control for the covariates including sex of the child, current age, age squared/100, household size, rural, usual monthly household consumption expenditure (in INR), upper caste, religion, and state fixed effects. The sample is all the children of the age group 6-17. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Household fixed effects

VARIABLES	Unpaid domestic services				Learning time			
	Clean fuel	Alternate fuel	Clean light	Alternate light	Clean fuel	Alternate fuel	Clean light	Alternate light
Female	34.97*** (1.415)	55.27*** (2.664)	42.77*** (1.612)	60.58*** (5.513)	0.250 (1.992)	-12.57*** (3.060)	-4.933*** (1.859)	-11.99* (6.803)
Age	-9.143*** (1.185)	-13.80*** (1.885)	-11.20*** (1.107)	-9.575* (5.141)	42.02*** (2.364)	55.86*** (3.155)	47.17*** (2.050)	61.32*** (8.428)
Age squared	61.84*** (5.466)	95.50*** (8.566)	76.16*** (5.112)	80.20*** (23.07)	-182.9*** (10.78)	-260.1*** (13.96)	-211.9*** (9.324)	-291.3*** (36.28)
Constant	18.20*** (6.165)	24.84** (10.25)	21.66*** (5.817)	-0.929 (28.29)	137.4*** (12.60)	75.01*** (17.59)	116.0*** (11.08)	30.66 (47.43)
Observations	34,621	23,464	55,042	3,043	34,621	23,464	55,042	3,043
R-squared	0.552	0.573	0.560	0.585	0.863	0.821	0.846	0.830

VARIABLES	Total self-development time			
	Clean fuel	Alternate fuel	Clean light	Alternate light
Female	-23.91*** (1.877)	-31.27*** (3.206)	-26.63*** (1.883)	-35.15*** (7.763)
Age	-17.15*** (2.510)	-19.40*** (3.215)	-17.98*** (2.152)	-24.06*** (7.224)
Age squared	34.49*** (10.90)	31.92** (14.25)	32.52*** (9.490)	58.69* (30.91)
Constant	1,195*** (13.91)	1,229*** (17.88)	1,208*** (11.87)	1,265*** (42.25)
Observations	34,621	23,464	55,042	3,043
R-squared	0.850	0.798	0.831	0.809

Note: All the regressions include household fixed effects and the robust standard errors in parentheses are clustered at the district level *** p<0.01, ** p<0.05, * p<0.1

Impact of clean electricity on children's time use

VARIABLES	unpaid domestic services (OLS)	unpaid domestic services (IV)	learning time (OLS)	learning time (IV)	total self-dev time (OLS)	total self-dev time (IV)
Clean light	-9.506*** (1.473)	-209.9*** (31.49)	30.22*** (4.080)	960.7*** (123.8)	-13.63*** (3.663)	-956.8*** (122.0)
Constant	27.30*** (3.652)	213.5*** (29.65)	101.7*** (13.35)	-762.7*** (117.0)	1,211*** (12.85)	2,087*** (115.3)
Controls	YES	YES	YES	YES	YES	YES
Cragg-Donald Wald F statistic		173.245		118.488		173.245
Observations	87,648	87,609	87,648	87,609	87,648	87,609
R-squared	0.163	-0.257	0.035	-0.829	0.031	-0.935

Note: In case of IV results the variable average domestic electricity prices across states have been used. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Pradhan Mantri Ujjwala Yojana: Eligibility criterion



Supplementary KYC Document & Undertaking (To be submitted along with PMUY KYC Document) (PS: To be published in vernacular languages)

Name of the Applicant:																				
Aadhaar of the Applicant:																				

Undertaking for availing LPG connection under Pradhan Mantri Ujjwala Yojna

Dear LPG Distributor,

I, _____ daughter/wife of _____ Age _____ years, resident of do hereby declare that I and my family members as per my family composition at the given address do not possess or meet any of the following exclusion criteria which will disqualify my application for LPG Connection under PMUY.

14 Point Declaration

- 1) Motorized 2/3/4 wheeler/fishing boat.
- 2) Paying professional tax.
- 3) Own Mechanized 3/4 - wheeler Agricultural equipment.
- 4) Dwelling in 3 or more rooms with pucca walls and roof.
- 5) Possess Kisan credit card with credit limit of over ₹ 50,000/-.
- 6) Owns a refrigerator.
- 7) Household member is a government employee.
- 8) Owns landline phone.
- 9) Households with non-agricultural enterprises registered with government.
- 10) Owns more than 2.5 acres of irrigated land with 1 irrigation equipment.
- 11) Do not have any member of household earning more than ₹ 10,000 per month.
- 12) 5 acres or more of irrigated land for two or more crop season.
- 13) Paying income tax.
- 14) Owning at least 7.5 acres of land or more with at least one irrigation equipment.

I hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake that if found untrue or incorrect or false, the Oil Company would be within its rights to withdraw the supply of Gas/Terminate the connection/seize the equipment's/forfeit the security deposit recover full loan amount if availed, subsidy amount for refill transferred and that I would have no claim whatsoever against IOCL/BPCL/HPCL for such withdrawal/termination/seizure/forfeiture/recovery.

I hereby declare that the above is read out to me and explained by the distributor / his/her authorized person and I have understood the same.

Name & Signature of the Applicant

Name: _____

Sign: _____

Date: _____ Place: _____

Policy Implications on the Children

Panel A: Subsample of households with consumption expenditure < 10,000						
Variables	Domestic service time		Learning time		Self-care time	
	Clean Fuel	Alternate Fuel	Clean Fuel	Alternate Fuel	Clean Fuel	Alternate Fuel
Female	39.80***	56.80***	1.202	-13.72***	-28.19***	-31.07***
	(1.917)	(2.954)	(2.640)	(3.402)	(2.405)	(3.555)
Observations	19,048	19,372	19,048	19,372	19,048	19,372
R-squared	0.552	0.580	0.863	0.825	0.851	0.799
Panel B: Subsample of households belonging to scheduled caste/scheduled tribe						
Female	41.38***	57.60***	4.686	-19.43***	-31.96***	-31.95***
	(2.108)	(3.931)	(3.406)	(4.724)	(3.550)	(5.956)
Observations	9,579	10,198	9,579	10,198	9,579	10,198
R-squared	0.564	0.573	0.856	0.834	0.849	0.796
Panel C: Subsample of households residing in kuccha house or no dwelling						
Female	40.66***	59.86***	5.972	-15.58**	-28.49***	-36.83***
	(5.278)	(5.007)	(7.688)	(6.530)	(6.875)	(6.525)
Observations	2,448	5,631	2,448	5,631	2,448	5,631
R-squared	0.556	0.583	0.828	0.820	0.852	0.794
Panel D: Subsample of households with land size < 5 acres (< 2.02 hectares)						
Female	34.58***	54.97***	0.0950	-12.99***	-22.90***	-30.10***
	(1.477)	(2.774)	(2.061)	(3.155)	(1.972)	(3.310)
Observations	32,544	21,860	32,544	21,860	32,544	21,860
R-squared	0.553	0.571	0.862	0.820	0.848	0.798
Panel E: Subsample of households living in abject poverty (fulfilling the above mentioned all 4 criteria)						
Female	58.09***	62.80***	-8.238	-31.56***	-27.13**	-28.52***
	(11.23)	(5.764)	(11.08)	(11.42)	(12.14)	(9.846)
Observations	680	2,506	680	2,506	680	2,506
R-squared	0.549	0.565	0.839	0.822	0.862	0.798

Note: In columns 1, 3 and 5 the subsample is limited to the households with access to clean cooking fuel and columns 2, 4 and 6 are limited to the regression with subsamples limited to the household with access to alternate cooking fuel arrangements. All the regressions include controls from age, age squared/100, household fixed effects and the robust standard errors in parentheses are clustered at the district level *** p<0.01, ** p<0.05, * p<0.1

Major Findings from the Study

- Participation in unpaid household work, learning activities, and self-development activities is gendered among children aged 6-17.
- Access to clean energy reduces unpaid domestic services time, increases learning time and reduces the self-developments time.
- The gender gap in unpaid domestic services and self-development activities narrows in households with access to clean energy (clean fuel, clean electricity).
- The PMUY scheme enhances children's human capital by potentially reducing the gender gap in time use.
- The results assert that strong policy interventions are needed to shift gender norms about unpaid domestic services.

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