



**HARVARD T.H. CHAN**  
SCHOOL OF PUBLIC HEALTH

Household technology and human development in low and middle-income countries:

## **Access to electricity and child health in 22 low and middle-income countries**

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THE  
TAKEMI  
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# Research questions

- RQ1. Does access to electricity improve child health?
- RQ2. If yes, do household goods used for food preparation and storage explain the relationship?

# Child health in LMICs

- Low-income countries and [middle-income countries]
  - 35% and [22%] stunted physical growth
    - Indicative of chronic undernutrition and repeated infections
    - Long term negative consequences for human development in terms of health and cognitive development
- Two leading causes of poor child health
  - Pneumonia (13% of deaths and 47% of stunting)
    - E.g., from indoor air pollution from cooking fuel
  - Diarrhea (9% of deaths and 35% of stunting)
    - E.g., from food contamination and water contamination
  - Undernutrition an important component
- Poverty an underlying cause

# Direct effects: Proximate determinants framework

- Electricity can make most aspect of household work more efficient
- Home appliances for food storage and preparation
  - Refrigerators
    - Reduced food contamination (environmental contaminants)
    - High-protein foods (nutrition)
  - Electric cooking equipment
    - Increased nutrient value (nutrition)
    - Reduced indoor air pollution (environmental contaminants)
    - Allow more frequent cooking (environmental contaminants)

# Effect heterogeneity

- Other social, economic, and behavioral factors need to be in place, e.g.:
  - Food distribution
    - To increase the utility of a refrigerator
  - Knowledge
    - About importance of proper food storage and household hygiene
  - Climate
    - Food contamination more likely when food is stored at high ambient temperature and in wet-climates

# Previous research

- Well established determinants of child health
  - Clean cooking fuel
    - Mixed results from randomized controlled trials
- Some evidence
  - Access to electricity on child health
    - E.g., access to electricity had a large causal effects on infant mortality in the U.S., 1930 – 1960

# Previous research

- Karlsson, O., Kim, R., Joe, W. and Subramanian, S.V., 2020. The relationship of household assets and amenities with child health outcomes: An exploratory cross-sectional study in India 2015–2016. *SSM-Population Health*, 10, p.100513.
- Consistent association for:
  - Appliances for storing and preparing food
- No consistent association for:
  - Most consumer goods (washing machine, radio, tv etc.)
  - Amenities (electricity, bank account, internet)
- Absence of association with electricity surprising
  - 88% of households have electricity
  - Not much variation in access within villages/neighborhoods

# Data

- Demographic and Health Surveys (DHS)
  - Large scale household surveys
  - Detailed health data on children under five years old
  - Detailed data on assets and amenities
  - Geocoded villages and neighborhoods
- Supplemented with data on power plants
- 22 countries including 135,052 children under five
  - Conducted after 2010
  - At least 20% of households without electricity
- Health outcome: Height-for-age z-score (HAZ)
  - Indicative of chronic undernutrition and repeated infections



Country	Year	Obs.	%
Angola	2015	6,357	4.71
Bangladesh	2014	6,965	5.16
Benin	2017	11,670	8.64
Burundi	2016	6,048	4.48
Cambodia	2014	4,324	3.20
Cameroon	2011	5,018	3.72
Chad	2014	9,787	7.25
Comoros	2012	2,367	1.75
Congo (DR)	2013	8,043	5.96
Cote d'Ivoire	2011	3,189	2.36
Ethiopia	2016	8,854	6.56
Guinea	2018	3,466	2.57
Haiti	2016	5,623	4.16
Lesotho	2014	1,312	0.97
Mali	2018	8,307	6.15
Myanmar	2015	4,213	3.12
Namibia	2013	1,554	1.15
Nigeria	2018	11,364	8.41
Timor-Leste	2016	5,872	4.35
Uganda	2016	4,422	3.27
Zambia	2013	11,343	8.40
Zimbabwe	2015	4,954	3.67
Total		135,052	100

# Methods

- Ordinary least squares linear regressions (OLS)
  - Difference in **HAZ** between children in household **with** and **without** access to **electricity**
  - Basic model adjusts for sub-region, age, sex, twin, (rural)
  - Full model adds covariates for:
    - Household owning a refrigerator
    - Household cooks with electricity
    - Household owning a television
    - Household socioeconomic status
    - Number of siblings

# Methods

- Gelbach (2016) decomposition
  - Quantifies how much of the difference in HAZ between households with electricity and without electricity is accounted for by each added covariates
    - **Owning a refrigerator**
    - **Cooking with electricity**
    - Owning a television
    - Household wealth
    - Maternal education
    - Number of siblings
- Only statistical impact of covariates; not mediation

# Methods

- Two-stage least squares (2SLS)
  - Distance to power-station an **instrument** for electricity access (Lewis, 2019)
  - Comprehensive data on power stations compiled by KTH Royal Institute of Technology
  - Distance correlated with access to electricity
  - Exclusion restriction: distance can only be correlated with child health through electricity access
    - Power plants located near water!
      - Past stunting and electricity access not correlated with opening of a new powerplant (within countries/sub-regions)
    - Building a power station causes economic development!
      - Our full models adjust for SES

	Mean	SE
Height-for-age z-score	-1.43	0.01
Access to electricity	0.35	0.01
Owns a refrigerator	0.12	<0.01
Cooks with electricity	0.03	<0.01
Female	0.50	<0.01
Age (months)	28.79	0.05
Twin	0.03	<0.01
Rural	0.71	0.01
Owns a TV	0.32	<0.01
Number of siblings	2.87	0.02
Mother's education (years)	4.45	0.04
Wealth index (z-score)	-0.09	0.01
Distance to power station (km)	156.40	1.82

Notes: Estimates are weighted equally for each country and robust standard errors (SE) adjusted for clustering.

OLS

<b>Outcome: Height-for-age z-score</b>	<b>Pooled</b>	<b>Urban</b>	<b>Rural</b>
Basic models: Electricity vs. no electricity	0.22 (0.02)	0.39 (0.03)	0.20 (0.02)
Full models: Electricity vs. no electricity	-0.05 (0.02)	0.01 (0.03)	-0.06 (0.02)
<i>Fridge vs. no fridge</i>	<i>0.09</i> <i>(0.02)</i>	<i>0.12</i> <i>(0.03)</i>	<i>-0.03</i> <i>(0.04)</i>
<i>Cooks with electricity vs. not</i>	<i>-0.10</i> <i>(0.04)</i>	<i>-0.02</i> <i>(0.06)</i>	<i>-0.19</i> <i>(0.06)</i>

<b>Decomposition of covariates added to full models</b>			
Owns a refrigerator	0.01 [5%] (0.01)	0.04 [11%] (0.01)	-0.00 [-2%] (0.01)
Cooks with electricity	-0.01 [-2%] <(0.01)	-0.00 [-1%] (0.01)	-0.01 [-3%] <(0.01)
Owns a TV	-0.00 [-2%] (0.01)	-0.02 [-5%] (0.02)	-0.01 [-3%] (0.01)
Household wealth	0.25 [83%] (0.01)	0.28 [76%] (0.03)	0.24 [95%] (0.02)
Number of siblings	-0.01 [-3%] <(0.01)	-0.01 [-2%] <(0.01)	-0.01 [-4%] <(0.01)
Maternal education	0.06 [19%] <(0.01)	0.08 [21%] (0.01)	0.04 [16%] <(0.01)
Observations	135,052	41,664	93,388

Notes: Covariates in basic regressions: sub-region, age, sex, twin, (rural). Estimates are weighted equally for each country robust standard errors in parenthesis adjusted for clustering.

## 2SLS

<b>Outcome: Height-for-age z-score</b>	<b>Pooled</b>	<b>Urban</b>	<b>Rural</b>
Basic models (Electricity vs. no electricity)	0.56 (0.15)	1.07 (0.30)	0.79 (0.24)
Full models (Electricity vs. no electricity)	-0.08 (0.59)	0.79 (2.11)	0.57 (0.58)
<i>Fridge vs. no fridge</i>	<i>0.09</i> <i>(0.03)</i>	<i>0.11</i> <i>(0.04)</i>	<i>-0.08</i> <i>(0.06)</i>
<i>Cooks with electricity vs. not</i>	<i>-0.10</i> <i>(0.11)</i>	<i>-0.14</i> <i>(0.33)</i>	<i>-0.33</i> <i>(0.15)</i>
<b>Decomposition of covariates added to full models</b>			
Owns a refrigerator	0.04 [6%] (0.02)	0.12 [13%] (0.03)	-0.02 [-4%] (0.02)
Cooks with electricity	-0.01 [-2%] (0.01)	-0.01 [-1%] (0.05)	-0.01 [-3%] (0.01)
Owns a TV	-0.01 [-1%] (0.11)	-0.04 [-4%] (0.27)	-0.06 [-16%] (0.08)
Household wealth	0.62 [86%] (0.28)	0.73 [78%] (0.75)	0.40 [106%] (0.22)
Number of siblings	-0.02 [-3%] (0.01)	-0.02 [-2%] (0.01)	-0.01 [-3%] (0.01)
Maternal education	0.10 [14%] (0.02)	0.15 [16%] (0.04)	0.07 [20%] (0.02)
Partial F-statistic from first stage: Basic [Full]	221.9 [26.3]	64.5 [2.5]	109.1 [31.8]
Observations	135,052	41,664	93,388

Notes: Covariates in basic regressions: sub-region, age, sex, twin, (rural). Estimates are weighted equally for each country robust standard errors in parenthesis adjusted for clustering.

# Conclusions

- Children in household with electricity have higher HAZ than children in households without electricity
- SES explains most of the relationship
- Potentially mediated by owning a refrigerator
  - Especially in urban areas
- No consistent impact of cooking with electricity



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