

Can Solar Lamps Replace Kerosene Candles and Improve Health, Education, and Safety of Non-Electrified Households?

By Chishio Furukawa, Brown University :: chishio_furukawa@brown.edu

- Applied Mathematics-Economics & Environmental Studies
- Details can be found in "Health and Safety Benefits of Replacing Kerosene Candles with Solar Lamps: Evidence from Uganda"



1. Background

1. Over **1 billion** people live without access to clean and safe lighting.
2. Over **60%** of Ugandan households use kerosene candles.
3. Kerosene candles PM2.5 (particulate matter) in concentration, **an order of magnitude higher** than the WHO health guideline.

2. Methodology



❖ Interventions

- Random distribution of solar lamps through a public lottery
- Kept the panels at schools in the first two weeks to avoid re-selling

❖ Randomized Evaluation in Kyannamukaaka, Uganda

❖ Participants

- 155 upper primary school students in 7 primary schools in Kyannamukaaka, who (1) use kerosene candles as main sources of lighting, (2) report some respiratory symptoms, and (3) parents participated in the household survey.



❖ Assessments

- Participants surveyed health conditions and tested spirometry every four weeks for 18 weeks
- Test scores before and after the public lottery

❖ Household Surveys

- ❖ Uganda National Household Survey (UNHS) 2005/06
 - UNHS contains data of over 7,300 households regarding their health, living conditions, educational attainment. This was collected throughout the year.
- ❖ Uwezo Uganda Learning Assessment Survey 2010/11
 - Uwezo Learning Assessment Survey contains data on educational attainment (literacy and numeracy) of over 93,000 children who go to schools.

3. Results & Findings

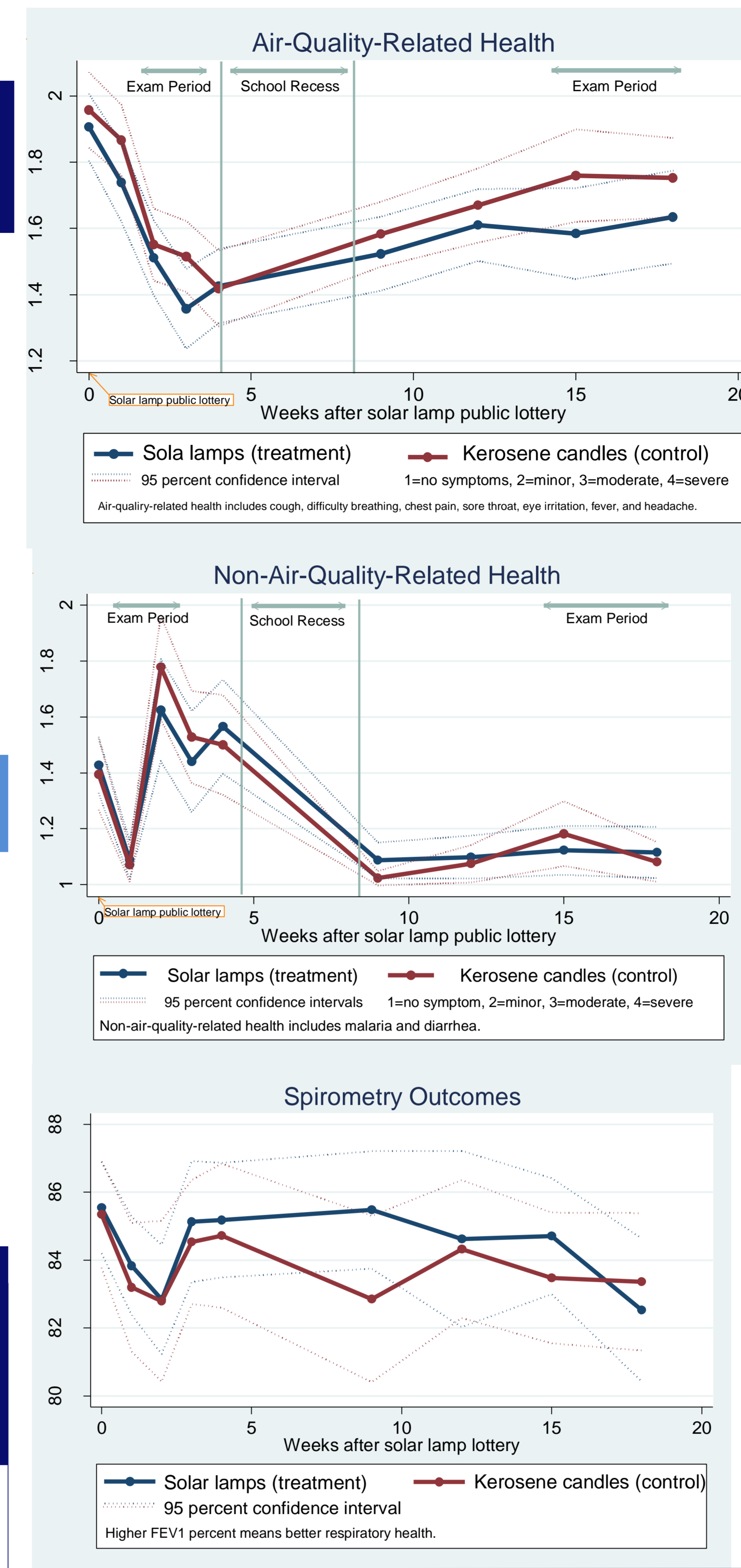
A. Modest Improvement in Air Quality-Related Health

❖ Randomized Evaluation

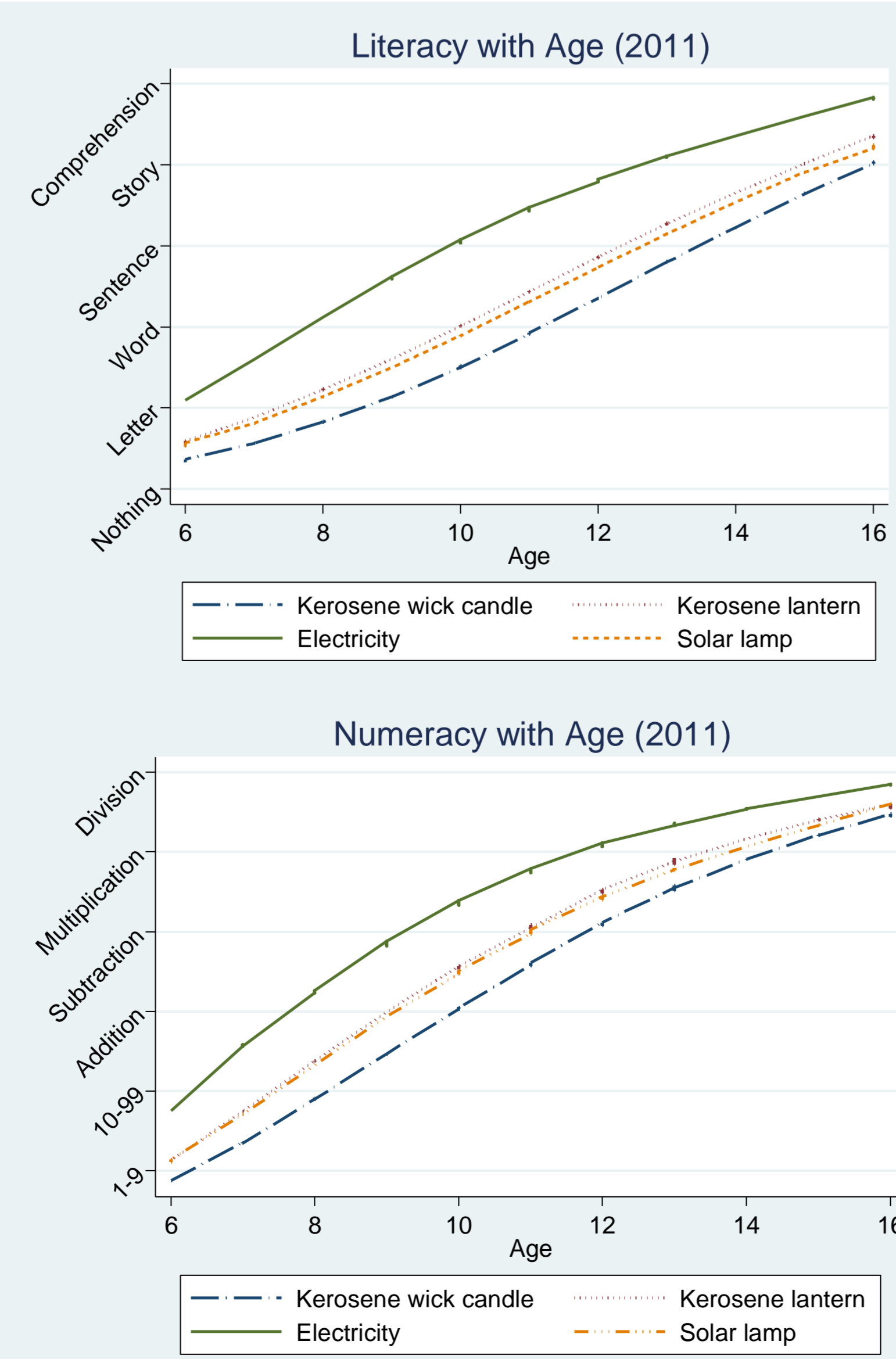
- ❖ A statistically significant and modest improvement in air quality-related health, especially during the exams.
- ❖ No improvement in non-air quality-related health (malaria and diarrhea).
- ❖ Some sign of improvement, but not statistically significant for spirometry. A "perverse" sign in the week 18.
- Consistent with epidemiological studies in that spirometer values often do not give immediate responses. 18 weeks was too short.

❖ Uganda National Household Survey 2005/06

- ❖ When the kerosene usage is especially high (i.e. exam periods), significant decline in air-quality-related health
- ❖ But possible confounded by variation in cooking times
 - During the exam periods, kerosene candle users had a higher kerosene consumption.
 - During the exam periods, kerosene candle users also had shorter cooking time.



B. No Obvious Improvement in Education & Learning Outcomes



❖ Uwezo Learning Assessment Survey 2011

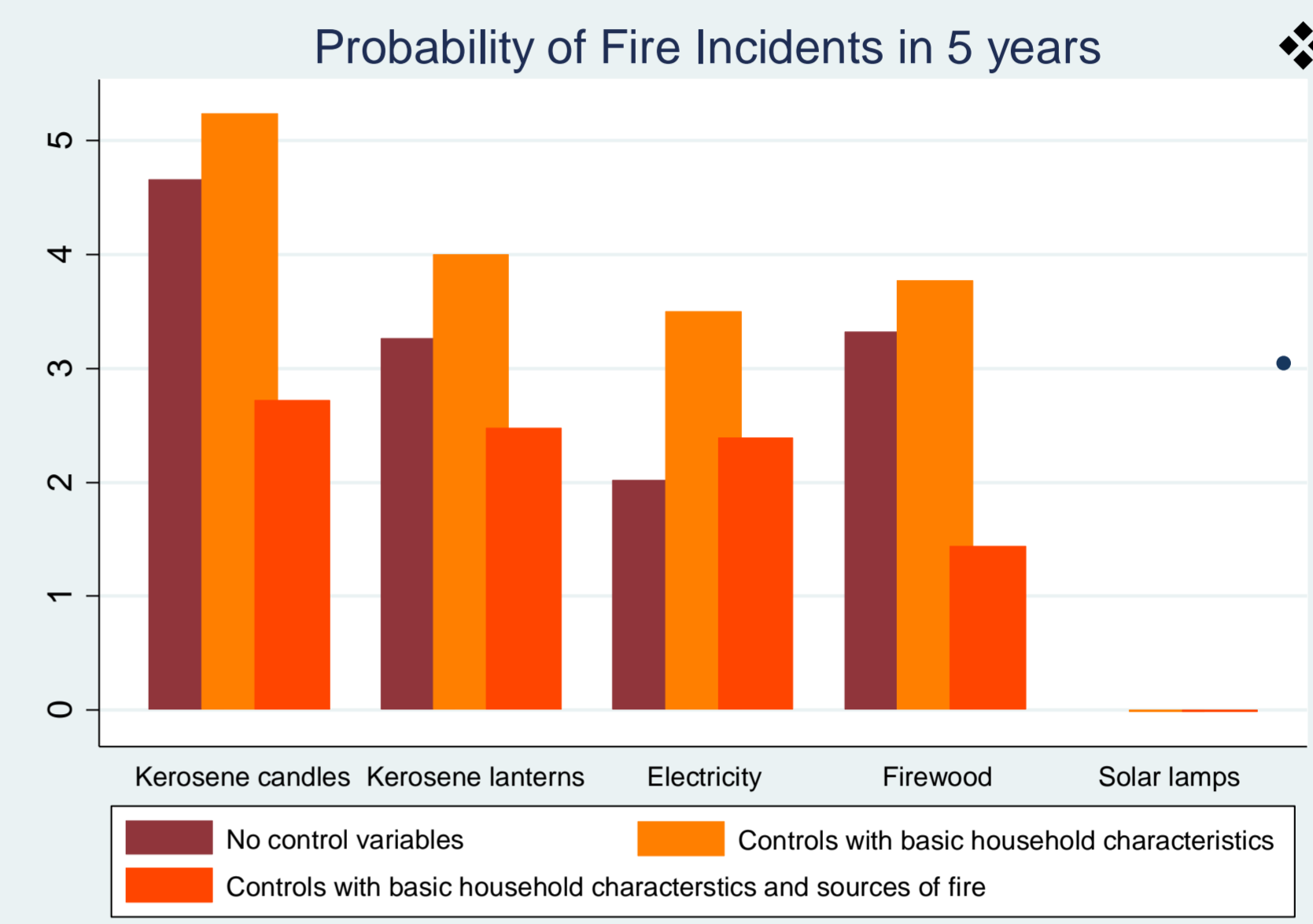
- ❖ No significant difference that can be attributed to difference in lighting sources.
- ❖ Although kerosene candle users had lower learning outcomes, the graph of learning achievement and age shows that this difference is not necessarily due to lack of lighting. (left)
- Note that the literacy and numeracy scores level off after the age of 10 because the tests were set at the level of primary 2.

❖ Randomized Evaluation

- ❖ Solar lamps users had statistically insignificant but lower achievements both in English and mathematics.
 - This may be due to the short time of this study.
 - This may also be due to the choice of cheapest solar lamps that gave off less bright light and often sparked when the battery was low.

C. Significant Reduction in Risk of Fire Incidents & Burn Injuries

❖ Uganda National Household Survey 2005/06



- ❖ Kerosene lamps are likely responsible for 70 percent of fire incidences and 80 percent of burn injuries.
- Since this analysis is essentially only simple regressions, this cannot claim causality. Nevertheless, additional checks demonstrate that reverse causality and omitted variable biases are likely not the major driver of this outcome.

4. Caveats: Challenges of Technology Adoption

1. Inadequate recharge

- Villagers had common difficulties to learn how to adequately recharge the lamps using the solar panels. For example (right), this villager puts the solar panel on the wall. However, this is not an efficient way to recharge since solar rays fall perpendicularly in Uganda.



2. Rainy Seasons

- Even with good recharging methods, often hard to recharge fully in rainy seasons.

3. Robustness of Lamps and Maintenance

- As the solar lamp company also aims to promote, maintenance services available in local areas will be very helpful to ensure immediate fixing.

4. Theft of Solar Lamps

- Since villagers have to leave the panels outside of their dwelling, solar lamps often got stolen during the day when the villagers work in their farms.

❖ Thank you!

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