Kyoto University
Institute of Advanced Energy

THE IMPACT OF RURAL ELECTRIFICATION ON QUALITY OF LIFE: LESSONS FROM SOUTH-EAST ASIA

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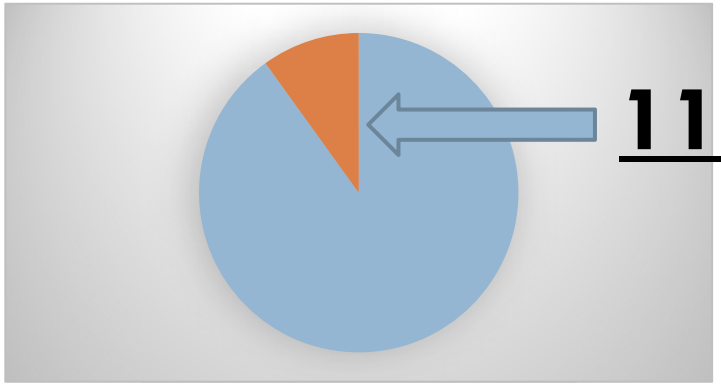
Presentation flow

1. *Introduction*
   - Why electrification?
   - Rural electrification and QoL literature
   - SE Asia as our case study
2. *Methods*
   - Countries, survey
   - Analysis methods
3. *Results*
   - Key findings, discussion
4. *Conclusions/future research*

How many people lack of electricity?

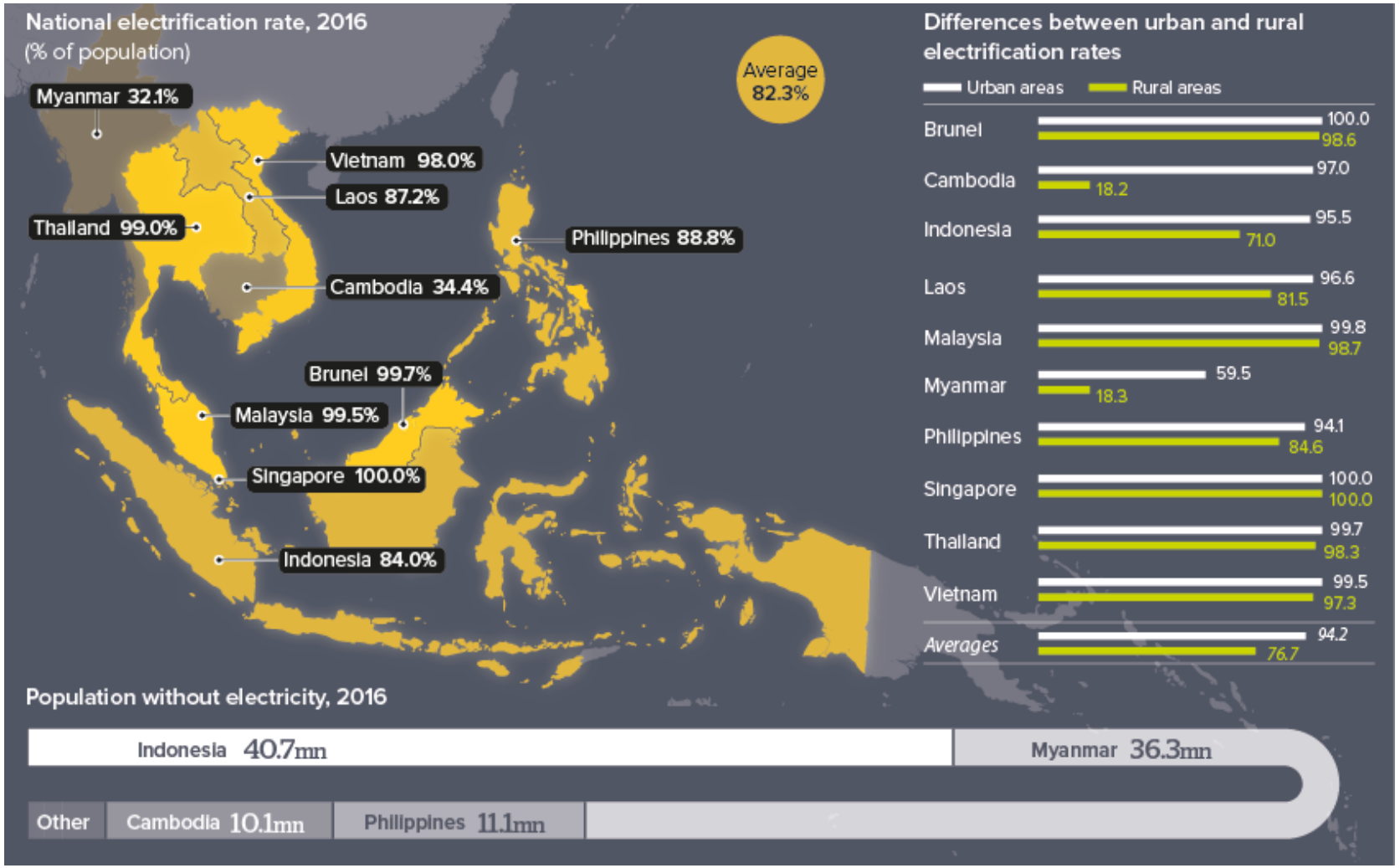
- Around 850 million people worldwide do NOT have access to electricity



11% of 7.7 billions (2019)

- Most live in **rural areas** of **developing countries**

What about South East Asia? (1)



https://dailybrief.oxan.com/Analysis/GA220581/Uneven-electrification-will-affect-ASEAN-competition

Is electrification important?

Electrification can:

- Improve children's education – **Lights** (SDG4)
- Improve sanitation and water access - **Pumps** (SDG6)
- Improve health – **Refrigeration, cooling, heating** (SDG3)
- Help use cleaner energy (SDG7)
- Better opportunities for women – **Time** (SDG5)
- Increase productivity, diversify activities, provide higher incomes (SDG8), reduce poverty (SDG1)

Electrification (rural areas) might also have negative impacts:

- Threaten local practices and culture
- Increase inequalities
- Create environmental and land rights controversies, etc.

Recent rural electrification (RE) studies

Article	Focus point	Setting	Cited
Palit (2011)	**Finance, institutions and governance**	South Asia	239
Dinkelman (2011)	**Employment, productivity, migration**	South Africa	692
Schillebeeckx (2012)	**Electrification business models**	(Review)	74
Khandker et al. (2012)	**Income, expenditure, poverty, schooling (infants)**	India	114
Kooijman-van Dijk & Clancy (2014)	**Production, financial capital**	Tanzania	86
Winther (2015)	**Gender (women's empowerment)**	Africa	21
Winther (2015)	**Impacts on living condition (household structures)**	Mozambique, Tanzania, India	14
Riva et al. (2018)	**Economic impacts**	(Review)	31

- 72,800 hits in google scholar (Jan 2020)
- Investigations focus mostly on economic, technology, or institutional issues
- Less emphasis on living conditions and **quality of life (QoL)**

RE literature focused on SE Asia

Article	Focus point	Setting	Cited
Martin & Sustanto (2011)	**RE and productive uses**	Lao PDR	12
Bhattacharyya (2013)	**RE experience and systems preferred**	Indonesia, Philippines, Thailand, Vietnam	8
Van Gevelt et al (2017)	**RE and productive uses, operation models**	Malaysia	7
Al Faruq et al (2016)	**Challenges to RE**	Indonesia	3
Saing (2017)	**RE, household consumption and children education**	Cambodia	4

- Substantially fewer studies than S. Asia and Africa
- Focus remains on productive uses and frameworks (only one study related to social issues and **none to QoL**)

Findings and gaps

- Lit. concentrates on prod. uses, econ., tech. or institutions
  - RE can bring improvements, but are highly contextualised
- Despite crucial, social effects much less examined
- Fewer information about the SE Asian region
  - Myanmar and Cambodia are serious gaps

Research objective:

- Analyse the effects of electrification on well-being in SE Asia, using a novel approach of measures in eight QoL domains.
- **This presentation will focus on some domains (Self-reported quality of life).**

Methods: analysis procedure

1. **Villages selection:**
   - No electrification, similar conditions
   - Community willingness to take part in the project
2. **Electrification scheme:** selection based on:
   - Economic capacity in the project
   - geographical features of location and proximity to grid
3. **Field survey (QoL questionnaire):**
   - Prior (baseline) and after electrification (endpoint)
4. **Post-processing analysis:**
   - Use statistical methods to reveal differences between stages.

Quality of life measures

Two categories:

1) Objective indicators (more common)
   - Infant mortality rate, life expectancy, mean years of schooling, gross domestic product, gross national income, water access, etc.
2) Subjective indicators
   - Self-reported quality of life, satisfaction levels, self-reported health, psychological well-being, social relations, aspirations, activities, etc.

Quality of life questionnaire

Eight well-being domains used in the Wisconsin Quality of Life Index (Diamond, 1999):

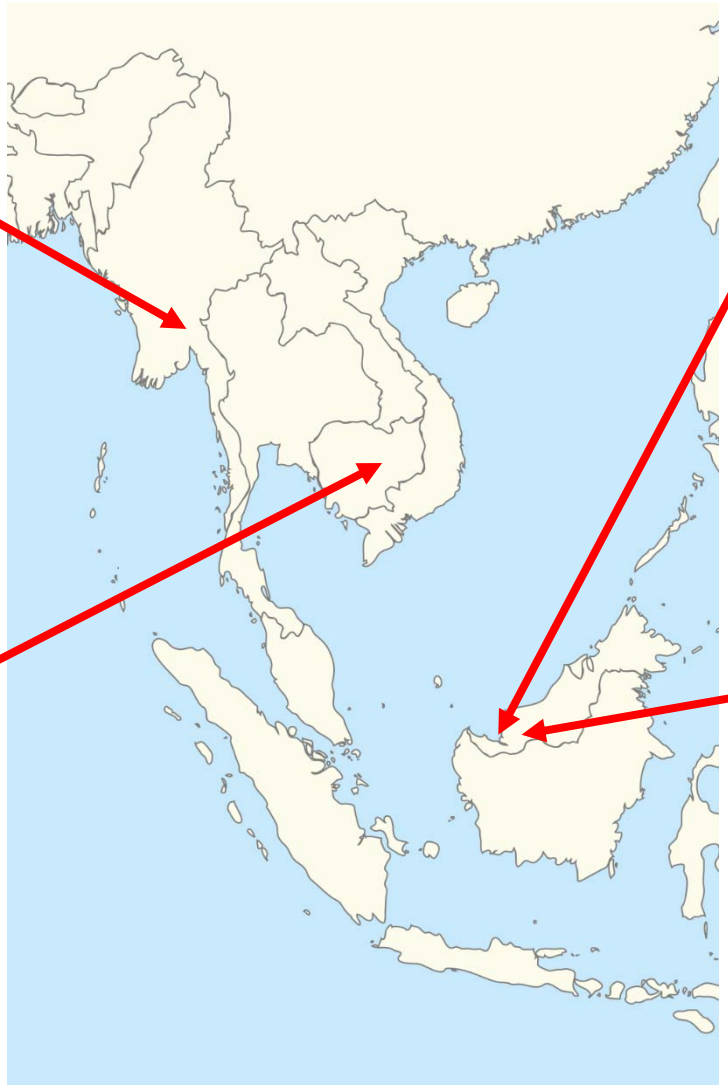
No	Category	Domains	Concepts	Items	Type of variable
I	Demographics	-	(1) Gender, (2) age, (3) education, (4) family type, and (5) occupation	5	Nominal
II	Quality of Life	Quality of Life (General)	(1) Self-reported quality of life	1	Ordinal (10p scale)
		Quality of Life (Domains)	Satisfaction with: (1) Time use, (2) time alone, (3) housing, (4) food	4	Ordinal (5p-likert scale)
		Psychological well-being	Self-reported mental health	1	Ordinal (5p-likert scale)
		Health well-being	Self-reported physical health	1	Ordinal (5p-likert scale)
		Social well-being	Perception on social support from family and friends	1	Ordinal (5p-likert scale)
		Economic well-being	(1) Feelings on amount of money owned (2) Feeling lack of money preventing activities (3) Income	3	Ordinal (5/4p scale) / Scale
III	Occupations	-	Satisfaction with (1) main activity, (2) hrs of work	2	Ordinal (5p-likert scale) / Scale
IV	Time of activities	-	(1) Wake up, (2) breakfast, (3) lunch, (4) dinner and (5) sleep time	5	Time scale

5p likert Scale: very unsatisfied (1) – very satisfied (5)

Selected locations

Oak Pho, Myanmar

Thmor Keo, Cambodia



Kampung Sungai Merah, Malaysia

Menangkin, Malaysia

Villages, schemes and surveys

Malaysia, Myanmar and Cambodia sites

- Income levels below national average
- Similar economic activities (mostly farming and fishing)
- Similar climate (tropical typical of the South-east Asian region)

Electrification schemes (3)

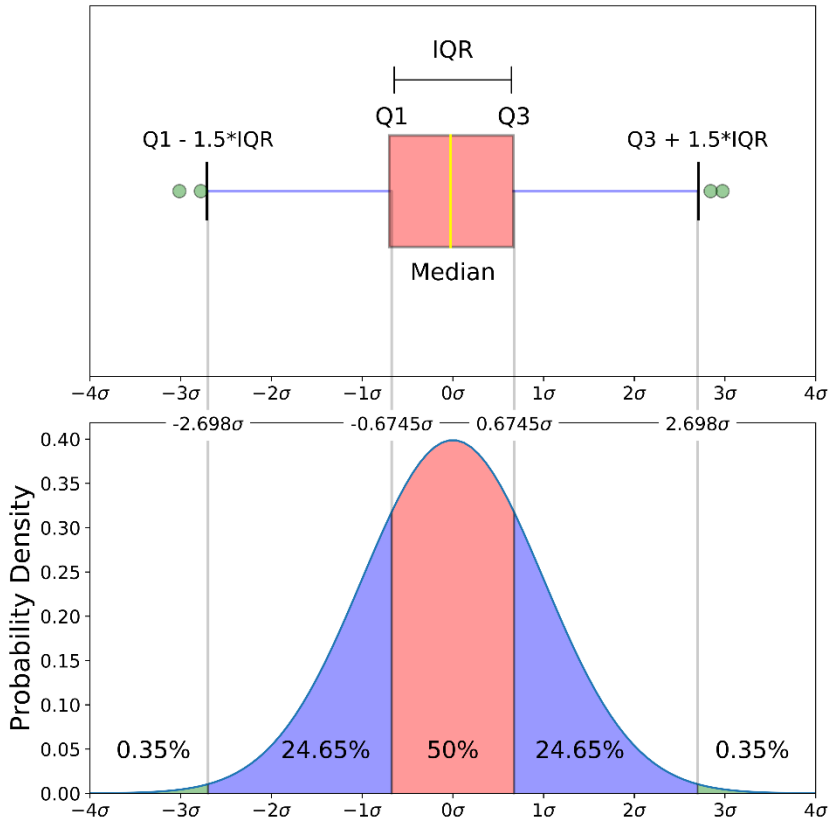
- Grid extension – centralised supply
- Hybrid systems (PV + diesel) - centralised supply
- Solar PV home systems – Individual supply

Endpoint surveys ~ 1 year after electrification.

Electrification Scheme	Village	Country	Demographics	Cultural profile	Surveys	
					Baseline	Endpoint
Grid Extension	Menangkin	Malaysia	22 households (~100 inhab.)	Iban	n=19 (Apr 2016)	n=12 (18m after)
	Thmor Keo	Cambodia	215 households	Khmer	n=17 (Mar 2017)	n=21 (13m after)
Hybrid system	Oak Pho	Myanmar	400 households (~2000 inhab.)	Bamar	n= 19 (Nov 2017)	n=35 (15m after)
Solar Home System	Kampung Sungai Merah	Malaysia	5 households (~20 inhab.)	Iban	n=6 (Dec 2016)	n=7 (17m after)

Analysis methods

a. Boxplot analysis



b. ANOVA plots

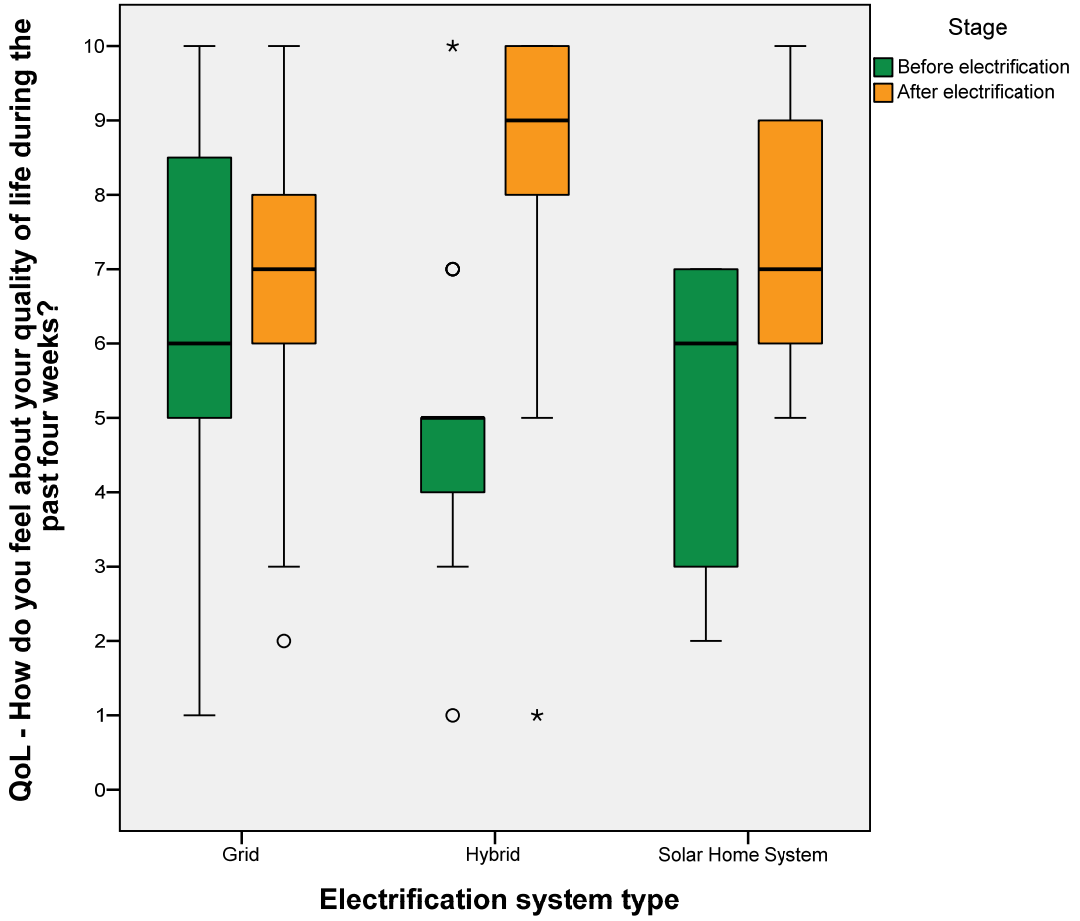
(*statistical tests verify if difference is significant)

Results (Self-reported QoL)

We find a similar tendency:

- ***Increase of QoL levels from electrification***
- ***Greater for hybrid system***

❖ **Confirms with <u>a more direct measure</u> the hypothesis that electrification is positive for well-being**

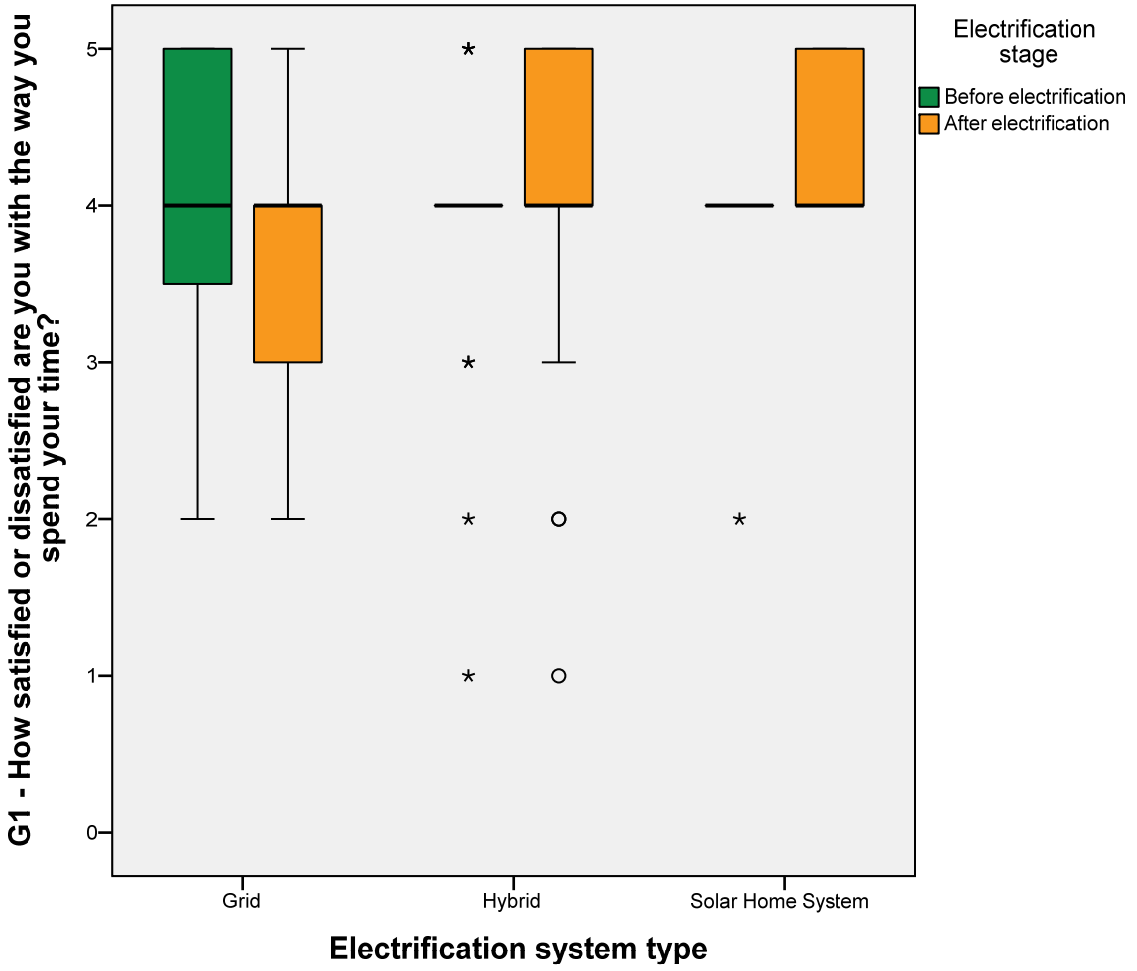


Results (Overall time use)

For Overall time use

No effect

- **QoL gains might not be fully related to the way that people spend time**
- **Electrification might not have a strong impact on this type of human need**
- **In SE Asia time is spent similar regardless of electrification**

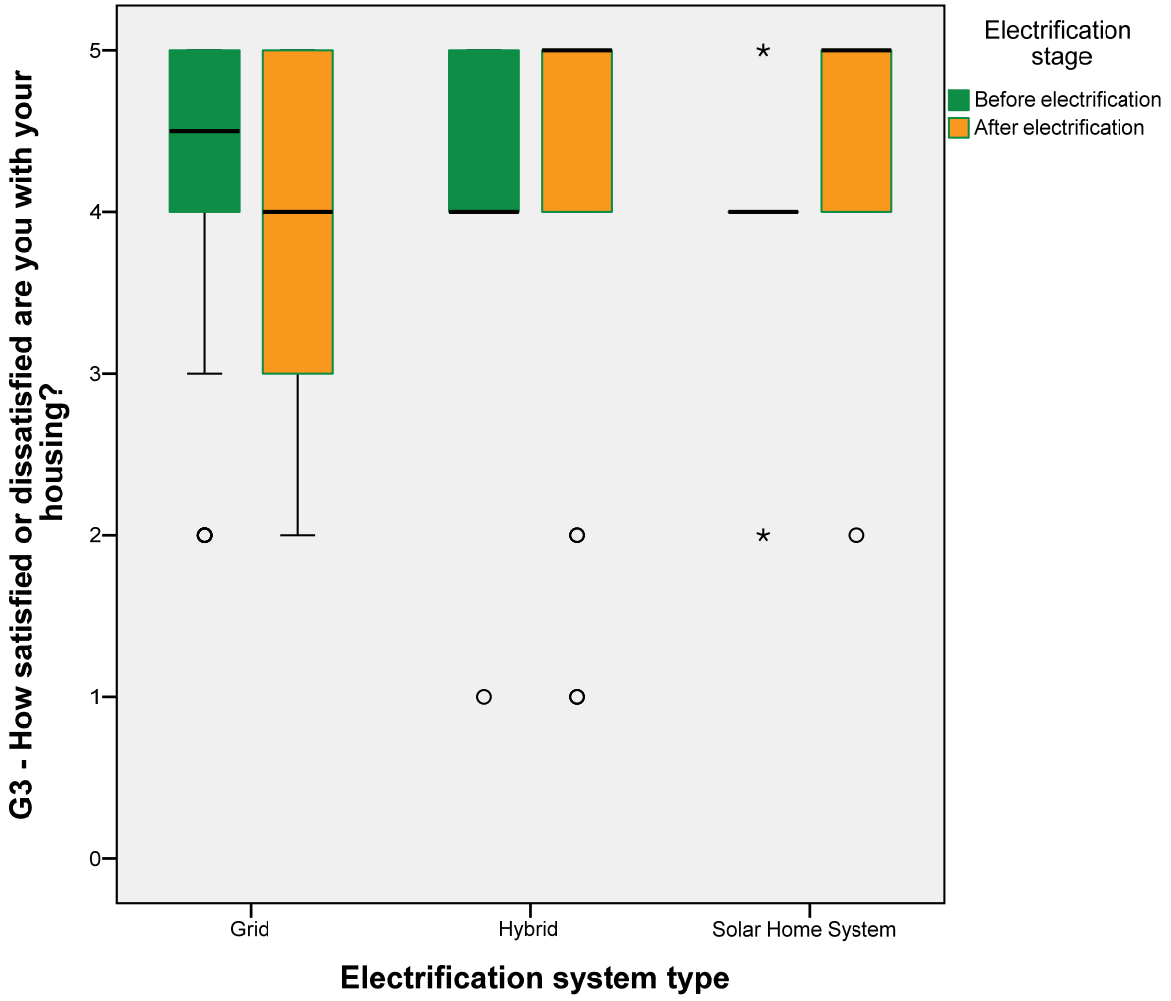


Results (Housing)

Surprisingly for housing

No effect

- **Probably because measure relates to house construction not energy services**
- **Longer span view might give different outcomes**

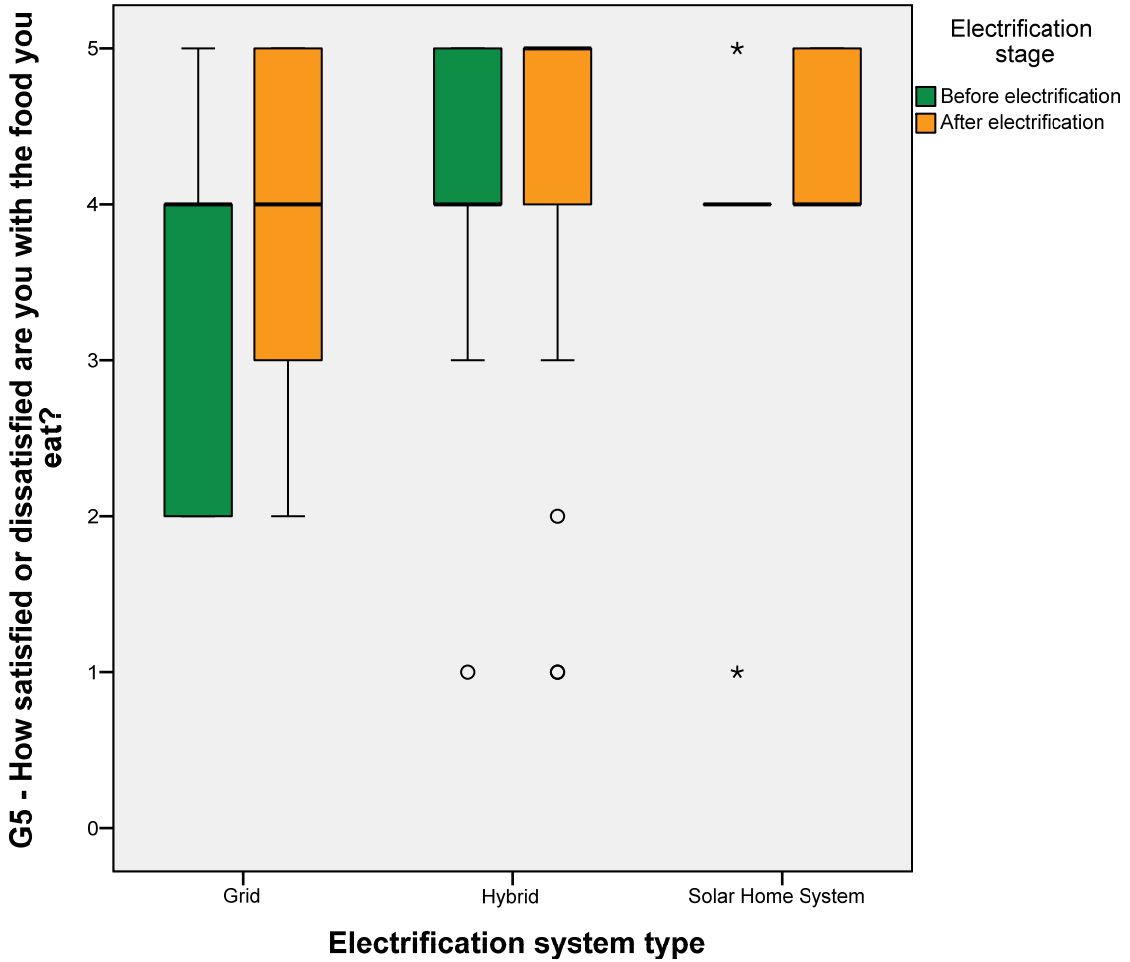


Results (Food)

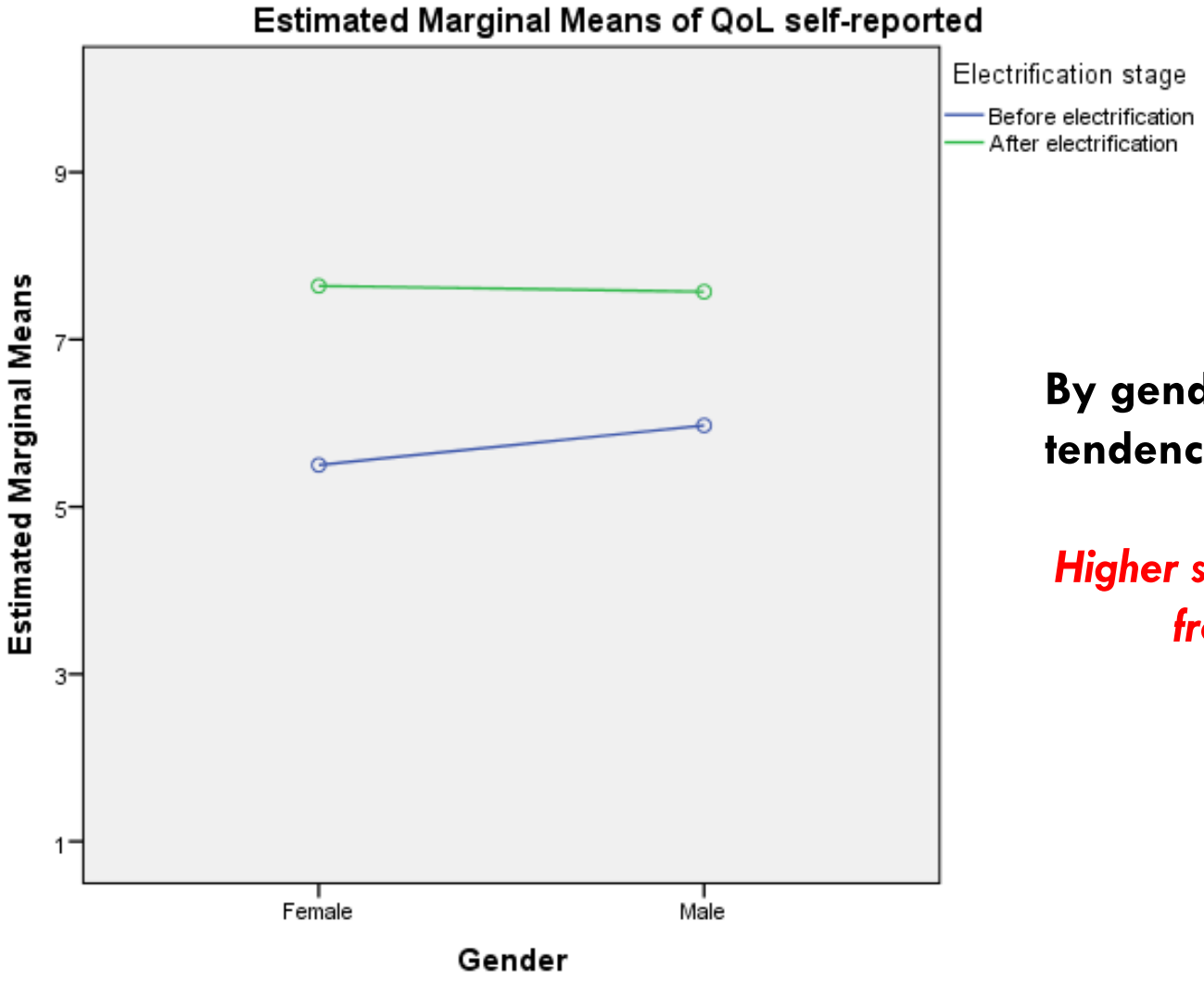
For the food related domain

QoL slight increases (less evident)

- **Use of rice cookers and fridge might explain this difference, particularly in grid extensions (not so much for Solar Home)**



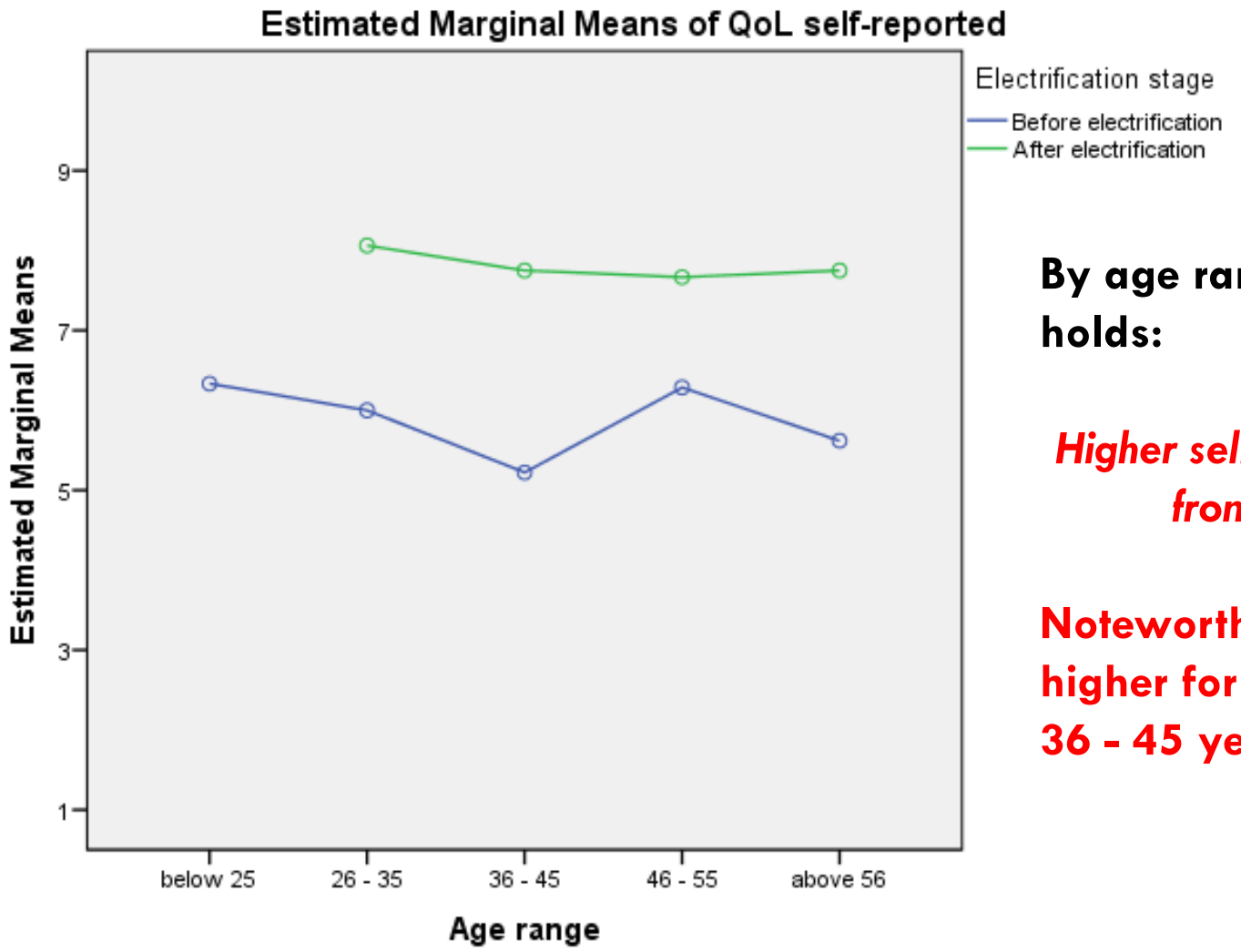
Self-reported QoL by **gender**



By gender, we find a similar tendency:

Higher self-reported QoL levels from electrification

Self-reported QoL by **age**

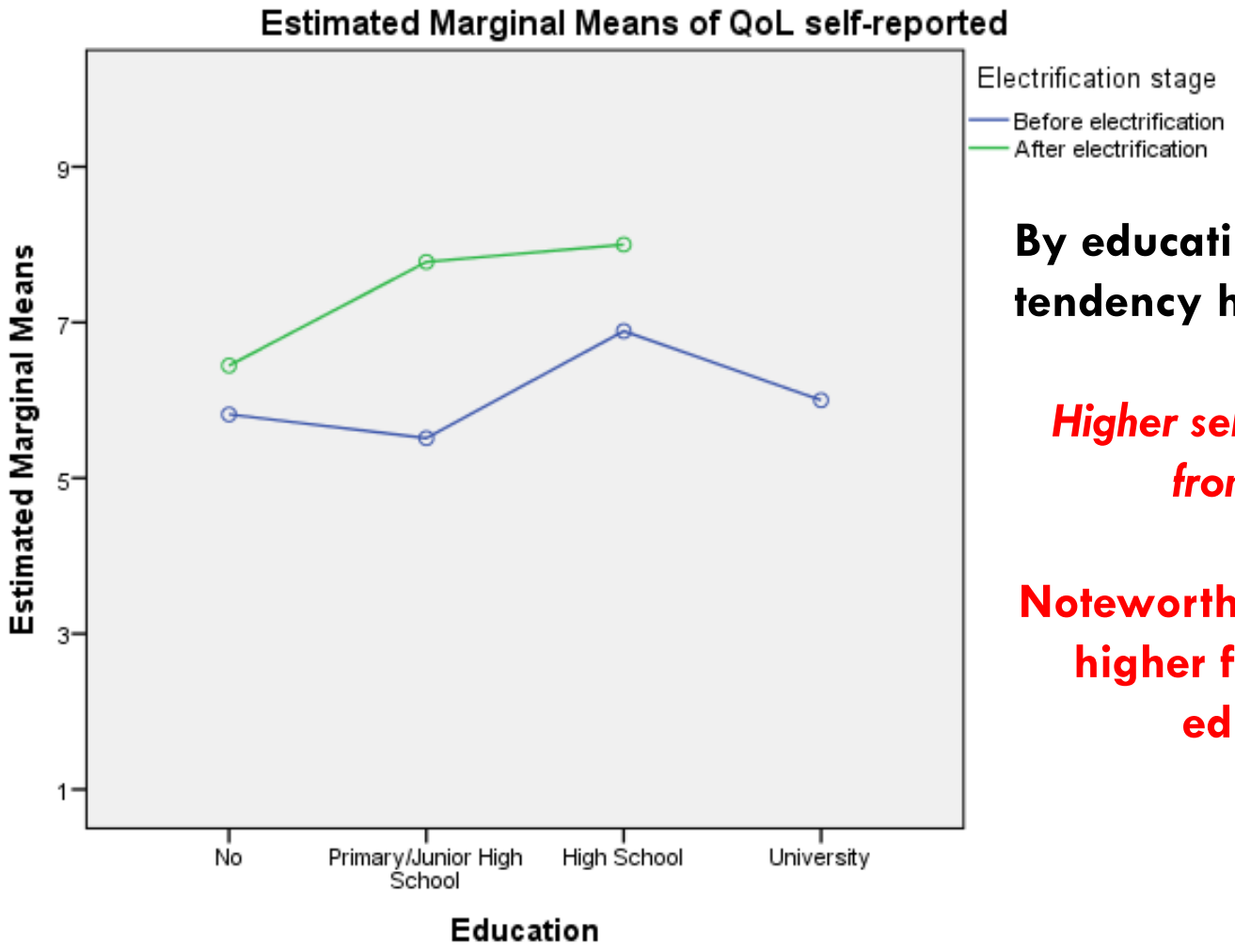


By age ranges, the tendency holds:

Higher self-reported QoL levels from electrification

Noteworthy, differences are higher for those in the 36 - 45 year old range

Self-reported QoL by **education level**

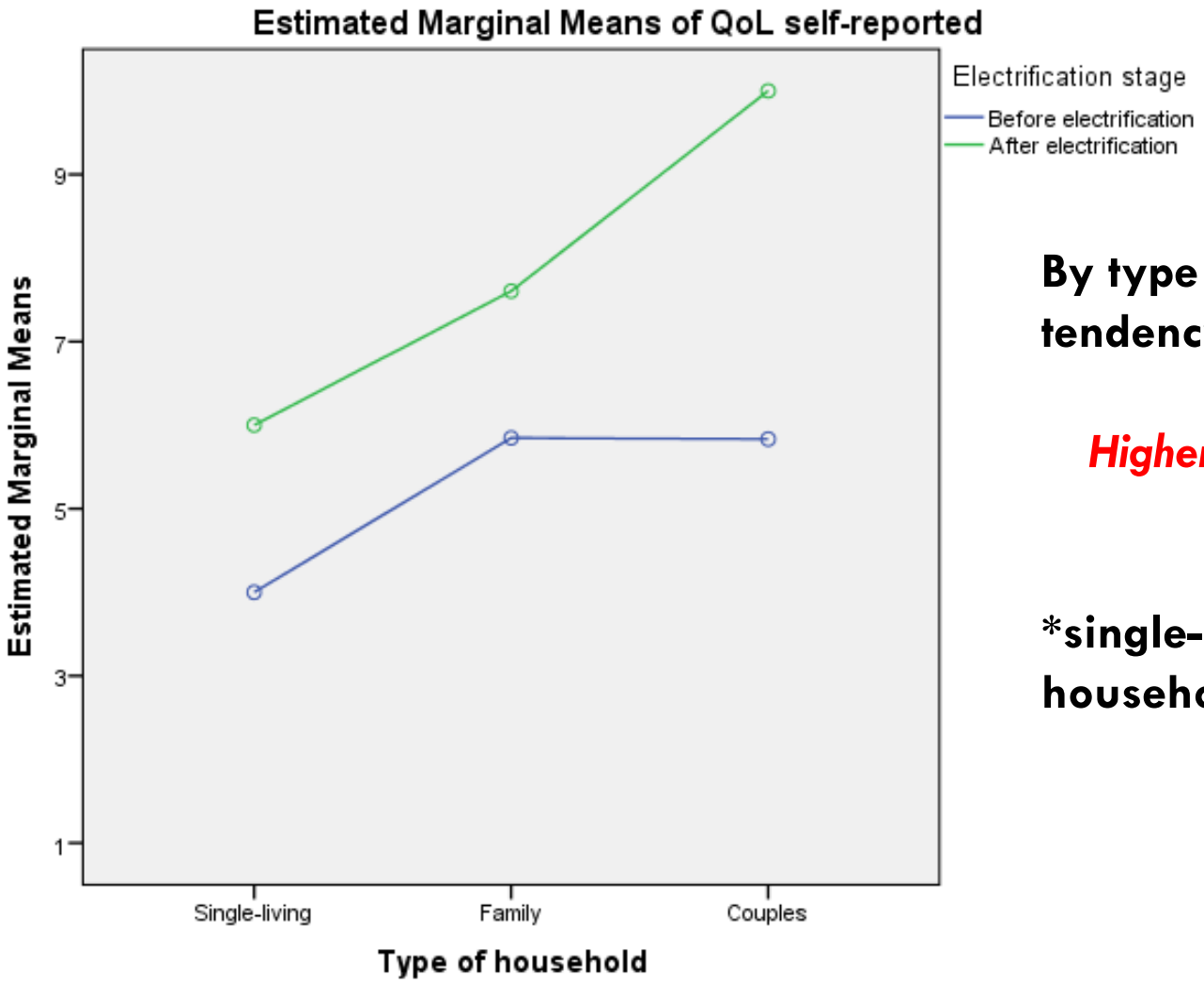


By education level, the tendency holds:

Higher self-reported QoL levels from electrification

Noteworthy that differences are higher for those with basic education levels

Self-reported QoL by **type of household**



By type of household, the tendency holds:

Higher self-reported QoL levels from electrification

***single-living individual household is rare**

Conclusions

- Observed a positive effect of electrification on QoL in SE Asia using on a more direct measure.
- Through different QoL domains, we observed different effects.
  - Notably, for domains on time use and housing satisfaction, there is no visible effect
- Through the demographic lenses, QoL increase is greater among the middle-aged, and people with basic education completed, as well as families without children.
- Overall, the results reflect short-term effects, further examination is needed for longer spans results and more conclusive findings.

Future research

- Further understanding of all domains
  - Examine what has changed in daily life
- Explore cultural meanings in more detail
  - Follow-up local interviews/observations to understand community values that explain outcomes
- Observe the dynamics and change in longer spans

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