Household-level variation of fluorosis outcomes in the Ethiopian Rift

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Objectives

- Describe variation in household fluorosis outcomes
- Evaluate environmental health knowledge and decision making
- Analyze relationship of demographics and social capital on health decisions
- Consider potential effects of climate change on water access and health

Environmental Health in the Rift Valley

- Arid subsistence farming and herding
- Limited water supplies; ground water is often contaminated with naturally occurring fluoride and other contaminants
- Climate change predictions indicate increasing strain on water supplies

Hypotheses

Potential paths of social factors (information and behavior)

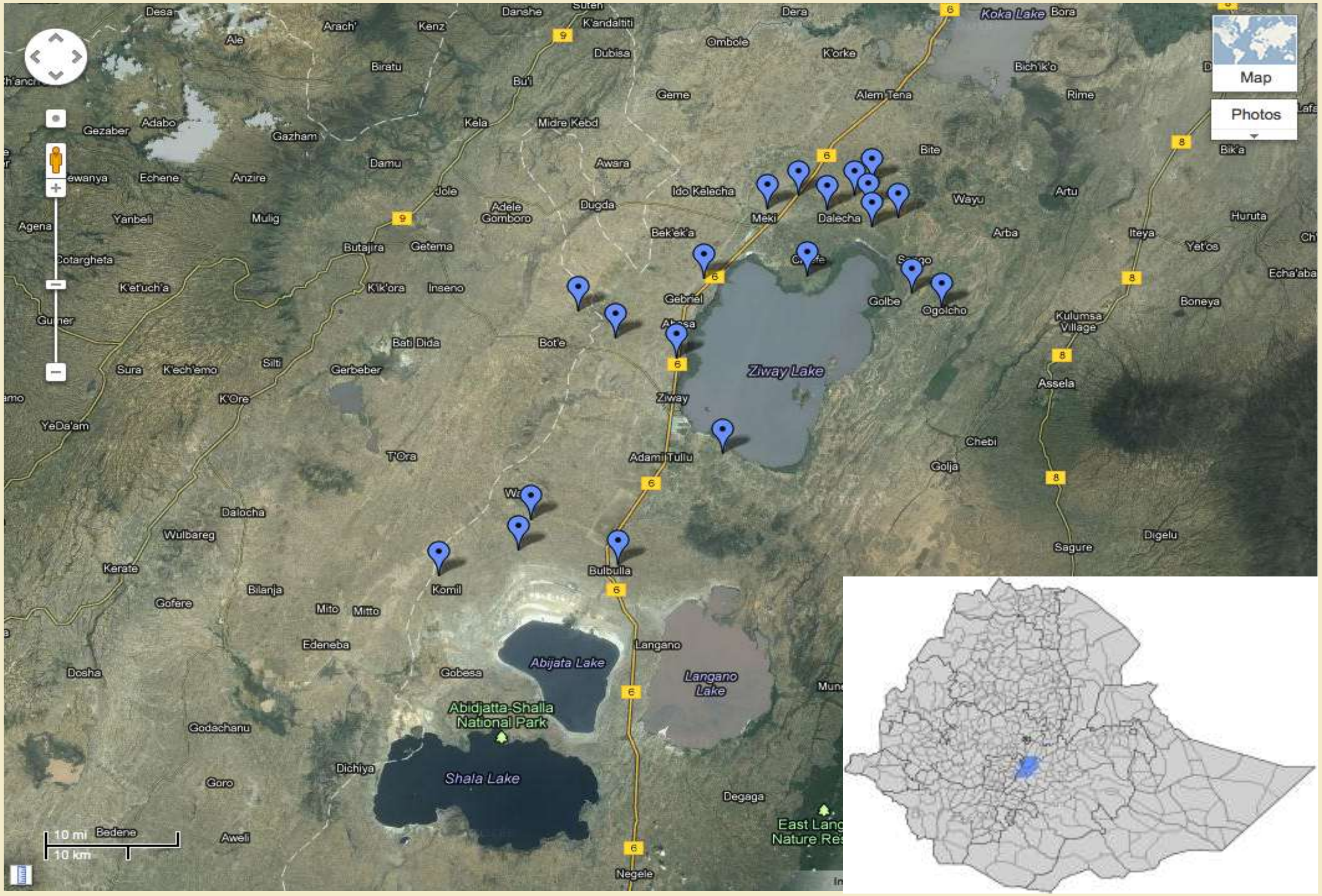
- Fluorosis prevalence and exposure
- Knowledge and behaviors alter health outcomes
  - Knowledge of fluorosis will be correlated with lower fluorosis levels
  - Frequency of milk consumption will be correlated with improved fluorosis outcomes
  - Higher social capital will be correlated with increased knowledge of fluorosis

Rango et al. *Environment international* 43, 2012.

Data

- Collected from December 2011 to January 2012
- 20 communities in 4 woredas
  - 11 from stratified resample of 50 previously tested boreholes wells
  - 9 villages randomly selected from 5936 CSA villages in basin of all water source types
- 399 randomly sampled households interviewed (~20 households per village) and 1094 individuals examined for health metrics and fluorosis

Data



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Kulumsa Village
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Adami Tullu
Chebi
Golja
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Wulbareg
Digelu
Sagure
Kerate
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Bulbulla
Bilanja
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Edeneba
Langano
Abijata Lake
Dosha
Gobesa
Langano Lake
Abidjatta-Shalla National Park
Godachanu
Dichiya
Shala Lake
Goro
Degaga
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10 mi
10 km
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Household Characteristics

- 56% female
- Average age: 37 years
- Language/Ethnicity: 93.5% Oromifa,
- 3% Amharic, 2.5% Gurage
- Religion: 50% Muslim, 43% Orthodox Christian
- Literacy: 47.7% (Male: 68%, Female: 32%)
- Average Household size: 6 people
- Median annual reported income: 6000 Birr (USD 332)

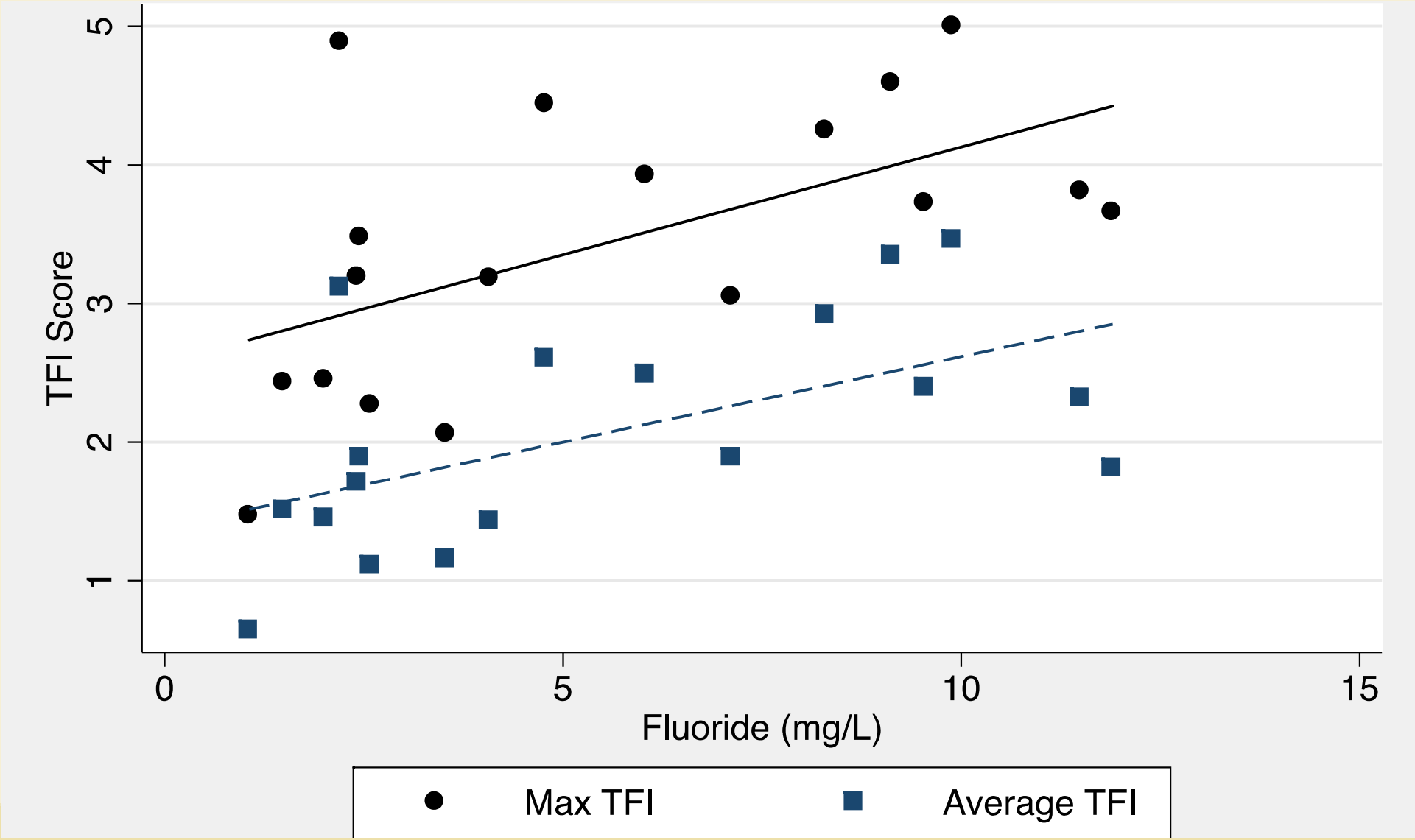
Water Use

- Household water sources
  - 67% use a borehole
  - 25% use a protected open well
  - 88% use surface water
- Little seasonality of water sources
- Average household expenditure on water: 62 B (USD 3.58) per month
- Average reported retrieval time: 33 minutes

Fluorosis

- Fluoride range of community water samples 1.49-11.9 mg/L
- Average fluorosis TFI level (0-9 scale): 2.56
- Average tooth maximum using TFI: 3.80
- 25% of households had some knowledge of fluorosis (as tested by questions on treatment and causes)

Fluorosis and TFI by village



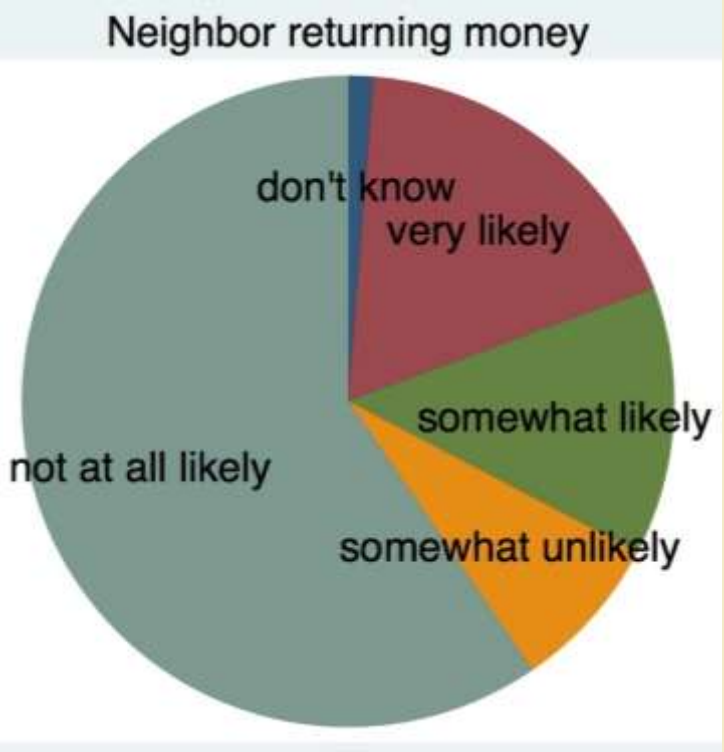
Agriculture and climate change

- 88% of farmers have experienced a crop failure in the past 10 years, and 49% have experienced more than two total crop failures
- 63% report less rains than 10 years ago with more disruptive patterns
- More than 20% of respondents had more than a month of water shortages in the past year.

Social capital

Survey measurement of social capital indicates relatively low levels of trust (42% say “people in village can be generally trusted.”)

Logistic regression results suggest a positive relationship between trust and knowledge of fluorosis



Fluorosis regression models

Participants' age>12

	TFI Average	TFI Max	TFI Average	TFI Max
Fluoride level (mg/L)	0.1653 ***	0.1861 ***	0.1356 **	0.1300
Age	-0.0173 *	-0.0363 ***	-0.0175 *	-0.0365 ***
Male indicator	1.0269 ***	1.3109 ***	1.0128 ***	1.2949 ***
BMI	0.0468	0.0182	0.0600	0.0482
Milk consumption			-0.1513 *	-0.2191 **
Fluoride level and Milk consumption interaction			0.0080	0.0156
Fluorosis knowledge			-0.5171	-0.7551 *
ln(income)	0.0779	0.1059	0.1028	0.1424
Observations	342	338	327	327

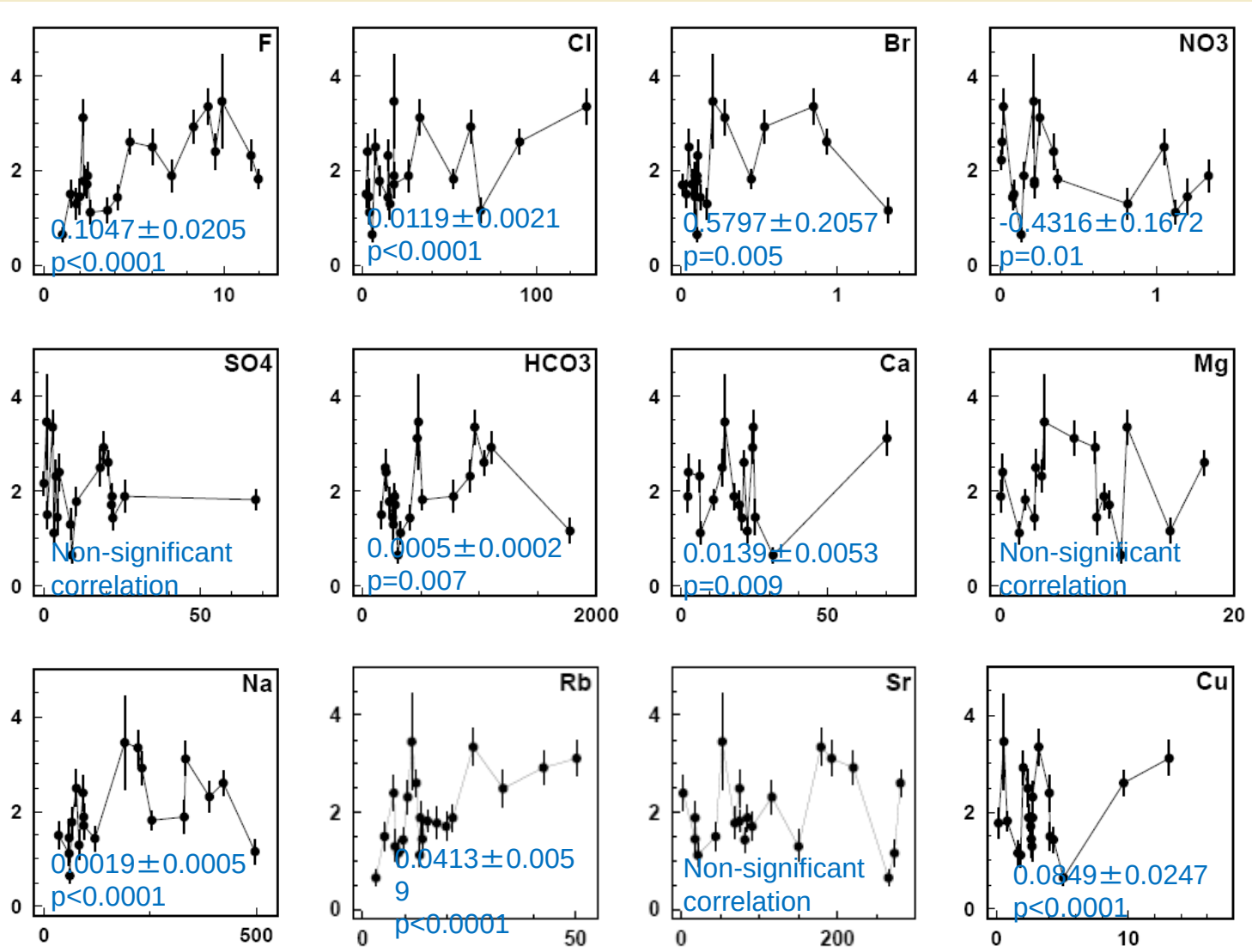
Where *, **, and *** indicate significant levels at p< 0.10, p< 0.05, and p< 0.01

Fluoride-modifying effects of other elements (Julia Krauchanka)

Principle Component Analysis

TFI vs. conc. of co-contaminants:

- Chlorine
- Rubidium
- Copper
- Cadmium
- Strontium



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Limitations

- Questions of causality
- Availability of alternatives determines choices
- Cross-cultural relevance of social capital questions
- Complexity of social factors in behavior

Conclusions and extensions

- Elucidation of household and community decision-making processes
- Climate and environmental health adaptation interventions must consider information factors
- Nutritional factors and co-contaminants may also be important in determining fluorosis.

Thanks

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