Predictors and Health Outcomes of Water Insecurity After a Flood Among an Indigenous Population in the Bolivian Amazon

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Introduction

- An urgent need exists to understand and address water insecurity as 783 million people lack access to safe drinking water (Wutich & Brewis 2014).
  - "Water insecurity" is defined as "insufficient and uncertain access to adequate water for an active and healthy lifestyle" (Hadley & Wutich 2009; Stevenson et al. 2012).
- Indigenous populations in developing countries are often the most vulnerable to natural disasters because of socioeconomic disparities (Few 2003).
- In particular, flooding places substantive stress on water systems and can disrupt many aspects of life and health (Ahern & Kovats 2013).
- Yet, little is known about how flooding contributes to water insecurity and health during rapid lifestyle transitions among indigenous populations.
  - In this poster, I assess the predictors of water insecurity following a flood and, in turn, the risks of diarrhea and dehydration among two indigenous villages at different stages of market integration.

Study Area: Beni, Bolivia

- Campo Bello (Market Integrated village): 1 hour by car from San Borja in dry season or 2-3 hours by motorized canoe in rainy season
- Anacehere (Traditional village): 2 days upriver by motorized canoe year-round

Methods

- 15,000 Tsimane' live in ~100 villages. Data come from an observational study in two Tsimane' villages during March-April, 2014 following a historically devastating flood.
- Interviews and anthropometric measurements using exhaustive sampling.
- Water Insecurity was a locally-adapted 9 question index addressing the three dimensions of water insecurity in the past month: access, adequacy, and lifestyle (Stevenson et al. 2012). Yes (Sometimes and always) = 1; No (or rarely) = 0.
- Categorical variable : Low water Insecurity (WI): 1-3; Medium WI: 4-6; High WI: 7-9.
- Health recall (7 days) coupled with doctor examinations. Diarrhea was defined as 3 or more bouts of diarrhea in any 24 hour period.
- Hydration levels: Urine samples collected. Urine specific gravity measured with refractometer (Atago) Uripen. Dehydration cutoff level >1.020 g/ml
- To assess water quality, we used the Hach PathoScreen field kit. The PathoScreen™ Medium detects the presence of hydrogen sulfide-producing bacteria incl. Salmonella, Citrobacter, Proteus, Edwardsiella, and Klebsiell. Indigenous E. coli does not interfere with the PathoScreen test, which makes it an excellent alternative to coliform testing.
- Analysis was conducted in Stata 13.0. Used OLS multiple logistic and linear regression to estimate models and the adjusted predicted probabilities to visualize effects.

Data

Water Insecurity Index

Water Insecurity Question	Yes
1) (In the last month,) have you been hurt getting water by falling or another reason?	15%
2) Have you been thirsty because there wasn't enough water to drink in your house?	43%
3) Have you been worried about the quality of your water?	86%
4) Has your house flooded because of too much rain?	85%
5) Have some of your crops died because of too much rain?	97%
6) Have you been unable to get enough water to make chicha (local traditional beverage)?	15%
7) Have you changed water sources from your primary source because that water was dirty?	59%
8) Have you or someone else in your family been sick because your water was dirty?	77%
9) Have you been worried that your children would get sick because your water was dirty?	85%

Water Sources, Quality Analysis, and Insecurity by community

Village	Water Source	No. (%) using source	Turbidity (NTU)	PH	Total Diss. Solids (ppm)	Iron (mg/L)	Pathog. Bacteria
Market Integrated Village	River	76 (40%)	143	7.2	56.1	3.3	Pos
	Stream	7 (3.7%)	--	--	--	--	--
	Well	38 (20%)	4	7.3	145.7	0.3	Neg
	Pump	50 (26.3%)	38	7.6	119.8	3.1	Neg
	Pond	19 (10%)	--	--	--	--	--
Traditional Village	River	52 (70.3%)	160	8.8	39.3	2.3	Pos
	Stream	22 (29.7%)	250	8.8	40.2	3.3	Pos

Water Insec.	Market Integ. Village	Trad. Village
Low	8 (9%)	5 (16%)
Medium	57 (66%)	17 (55%)
High	22 (25%)	9 (29%)

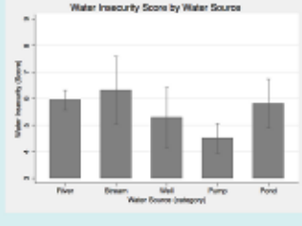
Insec: Insecurity; Integ: Integrated; Trad: Traditional

No: Number; NTU: Nephelometric turbidity units; Diss: Dissolved; ppm: parts per million; Pathog: Pathogenic

Results: Predictors of Water Insecurity

OLS linear regression & margins plot

Independent Variables[a]	Water Insecurity Beta	95% CI[b]
Water Source[c]: River (ref)	---	---
Stream	0.39	-0.79 1.56
Well	-0.76	-1.99 0.48
Pump	-1.31**	-1.95 -0.67
Pond	0.02	-0.85 0.88
Sex	0.01	-0.04 0.44
Age	-0.02**	-0.04 -0.01
Village: Market Integ (ref)	---	---
Traditional	-0.71+	-1.51 0.08
n (R^2)	118 (0.18)	

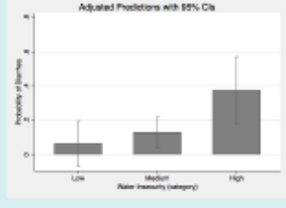


[a]Standard errors clustered by 62 households. [b]95% confidence interval. [c]Water Source is a set of dummy variables. Constant not shown. ** p<0.01, * p<0.05, + p<0.1.

Results: Water Insecurity and Diarrheal Illness

Logistic regression and margins plot of water insecurity on odds of adult diarrhea

Independent Variables[a]	Diarrhea OR[b]	95% CI[b]	P
Water Insecurity[d]: Low (ref)	1		
Medium	2.20	0.21-23.3	0.51
High	8.91+	0.75-105.9	0.08
Sex	0.77	0.35-1.67	0.50
Age	1.02	0.99-1.04	0.17
Village: Market Integ (ref)	1		
Traditional	1.03	0.30-3.6	0.96
n (Pseudo R^2)	118 (0.08)		



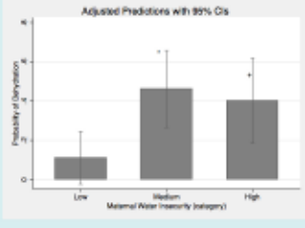
[a]SE clustered by 62 households. [b]Odds ratio. [c]95% confidence interval. [d]Water Insecurity is a set of dummy variables. ** p<0.01, * p<0.05, + p<0.1;

- Probability of diarrhea 37% among adults with High Water Insecurity vs 6% among adults with Low Water Insecurity.

Results: Water Insecurity and Dehydration

Logistic regression and margins plot of maternal water insecurity on odds of being dehydrated for children

Independent Variables[a]	Dehydrated OR[b]	95% CI[c]	P
Water Insecurity[d]: Low (ref)	1		
Medium	6.9*	1.09-43.7	0.04
High	5.4+	0.91-32.0	0.08
Sex	0.99	0.40-2.47	0.99
Age	1.01	0.87-1.18	0.85
Village: Market Integ (ref)	1		
Traditional	0.36	0.08-2.32	0.28
Temperature (°C)	1.35*	1.03-1.77	0.03
n (Pseudo R^2)	110 (0.11)		



[a]Standared errors clustered by household [b]Odds ratio. [c]95% confidence interval. [d]Water Insecurity is a set of dummy variables.
** p<0.01, * p<0.05, + p<0.1

- Probability of dehydration is 46% and 40% among children whose mothers report Medium and High Water Insecurity, respectively, while only 11% among children whose mothers had Low Water Insecurity.

Discussion and Conclusion

- Predictors of water insecurity relate to available water sources in the villages, market integration, and age. Individuals using hand pumps, the cleanest source, had the lowest water insecurity.
- Public health interventions may be increasing awareness that raw water sources are dirty.
- These messages may be reaching younger adults, especially in the more market integrated village as water-treatment posters are visible in the village school.

- Water insecurity for adults match onto probability of diarrhea for selves, while maternal water insecurity predicts probability of dehydration for their children.
- Flooding affects multiple dimensions of water insecurity.
- Water insecurity assessment is important for public health flood responses to consider as it reflects perceptions of stress related to water and can predict important water-related morbidities.

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