

Climate change, social vulnerability, and stunting in South Asia

Kathryn McMahon & Clark Gray

Motivation

Climate change is expected to harm child nutrition through multiple physical and economic pathways. We can estimate climate's impacts on child nutrition by examining trends in stunting, a measurement of impaired growth and an indicator of chronic undernutrition.

Heat stress

Climate shock

Infectious disease

Child stunting

Food & economic insecurity

South Asia is particularly vulnerable due to its extreme weather, existing nutritional deficits, and a lack of sanitation access, *but*:

- The **effects of temperature and mediating social factors** have been underexamined.

To fill this gap, **this study examines climate, stunting, and social vulnerability in Bangladesh, India, Nepal, and Pakistan.**

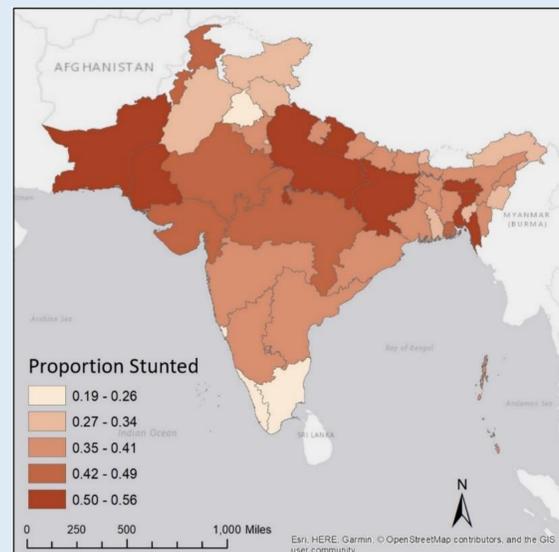
Data

Survey Data: Demographic Health Surveys (IPUMS-DHS)

- Nationally representative data on child nutrition and demography.
- **18 rounds** (1996-2018); **41 provinces**, standardized over time; **222,572 children** ages 24-59 months.

Climate Data: CRU and CHIRPS/CHIRTS

- Gridded **monthly** (CRU) and **daily** (CHIRPS/CHIRTS) **temperature and precipitation data.**
- Households linked **3 exposure periods**: prenatal (9 mo.), first year, and second year of life.
- We analyze **monthly anomalies** and **count extreme days** in each exposure period.



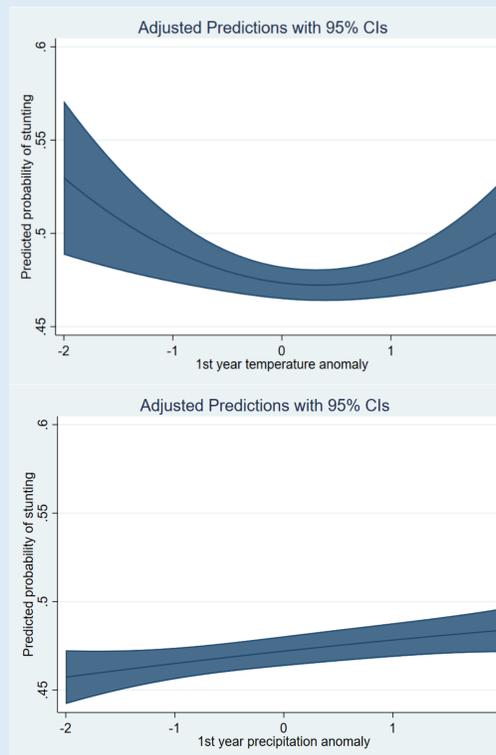
Proportion stunted among children ages 2-5 years, by province (Bangladesh 2014, India 2015-16, Nepal 2016, Pakistan 2017-18).

Variable	Prenatal anomalies		1 st year anomalies		2 nd year anomalies	
	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.
<i>Toilet quality</i>						
Unimproved	0.979 +	0.970 *	1.042 ***	0.968 +	1.040 *	0.947 *
Improved	0.990	0.998	1.013	1.001	0.994	0.972
<i>Mother's education</i>						
None	0.965 **	0.969 +	1.040 **	0.952 *	1.022	0.928 *
Primary	0.975 +	1.024	1.018	1.012	0.983	0.953
Secondary	1.000	0.993	1.009	0.982	1.043 *	1.004
Higher	0.997	0.964	1.049 +	1.091 +	0.956	0.954

Statistically significant interactive effects.

Disadvantaged social groups are more at risk of precipitation-induced stunting, but may benefit from warming temperatures.

Results



Statistically significant nonlinear effects.

Climate anomalies in the first year of life significantly affect health: all temperature extremes and severe rain increase stunting rates in South Asia.

Conclusions

Climate anomalies after birth increase stunting among vulnerable populations in South Asia, **BUT**:

- Initial warming may counteract this effect in the same populations.
- Improved toilet access could protect children against precipitation shocks.

Boyle, E.H.; King, M.; Sobek, M. IPUMS-Demographic and Health Surveys: Version 7. Minnesota Population Center and ICF International, 2019; Cooper, M. W., Brown, M. E., Hochrainer-Stigler, S., Pflug, G., McCallum, I., Fritz, S., Silva, J & Zvoleff, A. (2019). *Proceedings of the National Academy of Sciences*, 10, 1073; Dimitrova, A., & Muttarak, R. (2020). *Global Environmental Change*, 64.; Funk, C., Peterson, P., Landsfeld, M., Pedreros, D., Verdin, J., Shukla, S., ... & Michaelsen, J. (2015). *Scientific data*, 2(1), 1-21.; Funk, C., Peterson, P., Peterson, S., Shukla, S., Davenport, F., Michaelsen, J., ... & Mata, N. (2019). *Journal of Climate*, 32(17), 5639-5658.; Kumar, S., Molitor, R., & Vollmer, S. (2016). *Population and Development Review*, 53-68.; Randell, H., Gray, C., & Grace, K. (2020). *Social Science & Medicine*, 261, 113234.



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

This project was conducted with financial support from the Office of Undergraduate Research.